ORIGINAL ARTICLE

A study to investigate the relationship between difficult intubation and prediction criterion of difficult intubation in patients with obstructive sleep apnea syndrome

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Background and Aim: Obstructive sleep apnea (OSA) syndrome is predisposed to the development of upper airway obstruction during sleep, and it poses considerable problem for anesthetic management. Difficult intubation (DI) is an important problem for management of anesthesia. In this clinical research, we aim to investigate the relationship between DI and prediction criteria of DI in cases with OSA. **Materials and Methods:** We studied 40 [OSA (Group O, $n = 20$) and non-OSA, (Group C, $n = 20$)] ASA I-II, adult patients scheduled tonsillectomy under general anesthesia. Same anesthetic protocol was used in two groups. Intubation difficulties were assessed by Mallampati grading, Wilson sum score, Laryngoscopic grading (Cormack and Lehane), a line joining the angle of the mouth and tragus of the ear with the horizontal, sternomental distance, and tyromental distance. Demographic properties, time-dependent hemodynamic variables, doses of reversal agent, anesthesia and operation times, and recovery parameters were recorded. **Results:** Significant difference was detected between groups in terms of BMI, Mallampati grading, Wilson weight scores, Laryngoscopic grading, sternomental distance, tyromental distance, doses of reversal agent, and recovery parameters. **Conclusion:** OSA patient's DI ratio is higher than that of non-OSA patients. BMI Mallampati grading, Wilson weight scores, Laryngoscopic grading, sternomental distance, and tyromental distance evaluation might be predictors for DI in patients with OSA.

Key words: Difficult intubation, obstructive sleep apnea, predictive factors

INTRODUCTION

Obstructive sleep apnea (OSA) is a common disorder that affects all age groups. Patients with OSA are predisposed to the development of upper airway obstruction during sleep. The development of apnea leads to vigorous breathing efforts to open the collapsed airway, and arousal from sleep is followed by restoration of airflow. Such events are repeated with varying frequency throughout the sleep duration. Similar events are likely to occur when sedative or anesthetic agents depress consciousness. In patients with OSA syndrome, both functional and anatomical abnormalities may be implicated in pathogenesis of their disorder. In most patients, however, none of these abnormalities exist, and the etiology of OSA is not signposted.[1,2]

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This syndrome poses considerable problems for anesthetic management. OSA patients are predisposed to cardiac arrhythmias, myocardial ischemia, cerebrovasculer insufficiency, and intracranial hypertension. But difficult intubation (DI) is an important problem for induction period of the general anesthesia. Although there are good theoretical grounds to suspect an association between the severity of sleep apnea and the occurrence of DI, this remains speculative.[1-3] Some studies that concern anesthesia are rare and consist mainly of case studies or retrospective analysis in different patient populations and could have involved selection bias.

The purpose of this prospective clinical research is to investigate the relationship between DI and estimation criteria of DI of cases with OSA syndrome.

MATERIALS AND METHODS

After Ethic Committee approval and written informed consent were obtained, randomly 20 adult OSA patients (Group O) scheduled for tonsillectomy were induced in this prospective study. Concomitantly randomly 20 adult non-OSA cases whose were scheduled tonsillectomy during the same period were induced in the control

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group (Group C). In our experimental study the degree of sleep apnea was quantified by ENT Surgeon as "measuring the number of apneas and hypoapneas per hour of sleep (apnea-hypoapnea index, AHI) and the severity of oxygen desaturation during daytime somnolence. Exclusion criteria were determined hepatic or renal disease, cardiovascular insufficiency, drug allergy, asthma, chronic obstructive pulmonary disease hematologic disorder, pregnancy, drug or alcohol addiction, unstable angina pectoris and acute myocardial infarction (in the last six months).

The entire patient's demographic variables (age, height, weight, gender), body mass index (BMI), and ASA physical statuses were recorded.

BMI in which underweight, normal, overweight, obesity, and morbid obesity equal less than 19.0, 19.0 to 24.9, 25.0 to 29.9, 30.0 to 34.9, and greater than 35, respectively.

After fasting period (approximately 8 h) 18-20 G intravenous catheter was inserted to the dorsum hand, and 5 mL.kg^{-1} 0.9% NaCl solution was infused. Premedication was avoided to prevent respiratory depression.

In the operating room, all the patient's heart rate (HR), mean arterial pressure (MAP) and saturation of oxygen (SpO_2) monitored (Odam Physiogard SM 786 1995 France). Two anesthetists (blinded to research group) who each had minimum of 5 years experience in clinical anesthesia carried out airway assessment and laryngoscopy grading according to the protocol. Just before anesthesia induction, Mallampati score,[4] [Table 1], Wilson sum Sscore (WSS),[6] [Table 2], sterno-mental distance, tyro-mental distance, a line joining the angle of the mouth and tragus of the ear with the horizontal and atlanto-occipital joint movement measurement evaluations data were recorded. Patient's positions were supine with head in the sniffing. Cormack and Lehane grading[8] [Table 3] were noted down after induction of anesthesia.

Tyromental and sternomental distances (considering normal respectively over 6.5 and 12.5 cm), BMI (considering normal below 30), WSS (considering normal WSS ≤ 2) were all evaluated and recorded. The distances are measured in centimeters using a standard ruler. WSS combined five physical features. These factors were: weight, head and neck movement, jaw movement (inter-incisory gap measured in mouth fully open and subluxation of lower incisors), receding mandible, protruding maxillary anterior teeth. Each risk factor was given three possible scores (0/1/2). A total score greater than 2 predicts a greater risk of difficult intubation.

The entire standard anesthetic regiment is as follows: Induction: 3-5 mg.kg^{-1} Na-thiopental, 2 mg.kg^{-1} fentanyl and 1 mg.kg^{-1} succinylcholine. We preferred succinylcholine causes of it has a very short duration of action.

Table 1: Mallampati scores[5]

Class	Grading
1	Soft palate, fauces, uvula, and pillars visible
2	Soft palate, fauces, and uvula visible
3	Soft palate and base of uvula visible
4	None of the soft palate visible

Table 2: Wilson risk sum scores[7]

Variable	Risk factor	Level
Weight	<90 kg	0
	90–110 kg	1
	>110 kg	2
Head and neck movement	Above 90°	0
	About 90°	1
	Below 90°	2
Jaw movement [inter-incisor gap (IG) and subluxation SL)]	IG > 5 cm or SL > 0	0
	IG < 5 cm and SL = 0	1
	IG < 5 cm and SL < 0	2
Receding mandible	Normal	0
	Moderate	1
	Severe	2
Buck teeth	Normal	0
	Moderate	1
	Severe	2

Table 3: Cormack and Lehane scoring[9]

Grade	Observation
1	Full view of glottis
2	Only posterior commissure is visible
3	Only the tip of epiglottis is visible
4	No glottic structure is visible

Number of intubation attempts and reintubation in groups were recorded.

Anesthesia was maintained with 1.2% isoflurane in 4 L/min 50/50 O_2/NO_2. After endotracheal intubation patients were ventilated mechanically. If the MAP values were increased 20% than control values or HR more than 100 beat/min; IV 50 µ.g fentanyl added. At the maintenance period of the anesthesia, 0.1 mg.kg^{-1} pancuronium was given if necessary. When the MAP <70 mmHg crystalloid or colloidal solution was infused.

Heart rate, MAP, SpO_2 values were recorded just before induction (T0), after induction (T1), after endotracheal intubation (T2), end after that 5 min (min) intervals in the first 30 min (T3, T4, T5, T6, T7) 30 min. (T8), 60 min. (T9), at extubation (T10), end after extubation that 5 min (min) intervals in the first 30 min (T11, T12, T13, T14, T15, T16, T17) 30 min. At the end of the surgery, patients ventilated 100% O_2 and 0.015 mg.kg^{-1} atropin+0.04 mg.kg^{-1} neostigmin was given as reversal agent. After that, total Na-thiopental, suxamethonium chloride, fentanyl, pancuronium consumption, extubation time, recovery parameters (eye opening time, response to the verbal stimulus, name saying, saying the date of birth, up lifting the arm, up lifting the leg, anesthesia and operation time were recorded. From the end of anesthesia the time to eye opening (defined as the time until eye opening on command), the time to responds to the verbal commands, the time to saying the date of birth, the time to up lifting the arm, the time to up lifting the leg were recorded.

Patients' HR, MAP, SPO_2 values were monitored again in the recovery room and observed for an hour. If the patient complained of nausea or vomiting, IV 10 mg metoclopramide (MetpamidÒ) administered.

Statistical analyses were performed by SPSS 11.0 version statistical package for Windows. Parametric values were evaluated with the Student *t* test. Nonparametric values were compared using the Mann-Whitney *U* test. modified Cormach and Lehane score, BMI, doses of reversal agent, Mallampati Scores, Wilson head and neck movement, Wilson chin movement, receding chin, prominent canines, a line joining the angle of the mouth and tragus of the ear with the horizontal, gender, and ASA status were compared using *Chi-square* and *Fisher exact tests*. $P < 0.05$ was considered statistically significant.

RESULTS

In this research, 40 adult patients scheduled tonsillectomy under general anesthesia in half of them with OSA (n = 20) were studied. Patient's demographic properties are shown in Table 4. Weight and height values were marked significant in groups. Age, gender, ASA physical status, anesthesia and operation time values were similar in groups. Coexisting disease (coronary artery disease, heart failure, hypertension, pulmonary hypertension, smoking history) are similar to that in groups in Table 5.

Table 4: Demographic properties, ASA physical status, anesthesia time and operation time (mean ± SD, (*n*))

Variables	Group O (*n* = 20)	Group C (*n* = 20)	*P* values
Age (year)	41.5 ± 11.8	43.1 ± 14.3	0.693
Height (cm)	181.9 ± 8.5*	173.3 ± 9.6	0.004
Weight (kg)	96.6 ± 12.7*	75.6 ± 14.2	<0.0001
Gender (F/M)	2/18	8/12	0.087
ASA (I/II)	16/4	12/8	0.168
Anesthesia time (min)	90.2 ± 38.2	104.5 ± 46.5	0.055
Operation time (min)	73.8 ± 35.4	95.8 ± 42.6	0.056

*$P < 0.05$, Comparison with Group C

Time dependent HR and MAP values were in normal clinical range and similar in groups. Perioperative SpO_2 values are shown in Figure 1. SpO_2 values were significantly lower in Group O than Group C during first 20 min in post-extubation period [Figure 1].

There were statistically significant difference in Mallampati scores, Wilson weight scores, doses of reversal agent in groups ($P = 0.001$, $X^2 = 17.33$; $P < 0.0001$, $X^2 = 17.60$; $P < 0.0001$, $X^2 = 19.909$, respectively). But Wilson jaw movement, receding mandible, prominent canines, atlanto-occipital joint movement, a line joining the angle of the mouth and tragus of the ear with the horizontal parameters were similar in groups. Sternomental and tyromental distance mean values were shorter in Group O than Group C [Table 6].

During laryngoscopic observation (with Cormach and Lehane grading), significant difference were obtained in Groups: 1st. degree 70% patients in group C, 3th degrees 30% and 4th degrees 10% in Group O; $X^2 = 18.000$, $P < 0.0001$), [Table 7].

Number of intubation attempts and reintubation in groups were similar in groups ($P = 0.323$).

Postoperative recovery scores in Group O were shown significant difference than Group C at 0, 2, 4, min [($P = 0.030$, $P < 0.0001$, $P < 0.0001$, respectively), [Figure 2]]. But there was no significant difference at 6, 8,10, 15, 20 min. Recovery scores of the patients are shown in Table 8, and there was no statistical significant difference in groups.

DISCUSSION

OSA syndrome poses considerable problems for anesthetic management. One is height sensitivity to central depressant drugs, with upper airway obstruction or respiratory arrest occurring even with minimal doses. Anesthetic managements of the OSA patients, sedative and opioid premedication should be omitted, and drugs should be administered by titration to desired effect.[1] In our research, we did not administer sedative premedication and used standard anesthetic protocol for anesthetic management in each groups.

Table 5: Coexisting disease in groups (*n*)

Coexisting disease	Group O (*n* = 20)	Group C (*n* = 20)	*P* values
Coronary artery disease	1	-	1.000
Heart failure	-	-	-
Hypertension	4	3	0.677
Pulmonary hypertension	-	-	-
Smoking history	5	4	0.705

Table 6: Body mass index, doses of reversal agent, Mallampati scores, Wilson head and neck movement, Wilson chin movement, receding chin, prominent canines, A line joining the angle of the mouth and tragus of the ear with the horizontal, sternomental distance, tyromental distance, number of intubation attempts and reintubation (*n*, %, cm)

Variables	Group O (20)	Group C (20)	*P* values
BMI (0/1/2) (%)	2/12/6*	14/2/4	0.006
	(10/60/30%)	(70/10/20)	χ^2 = 16.453
Doses of reversal agent (1/2/3) (%)	4/14/2*	18/2/0	<0.0001
	(20/70/10)	(90/10/0)	χ^2 = 19.909
Mallampati (1/2/3/4) (%)	4/4/8/4*	8/12/0/0	0.001
	(20/20/40/20)	(40/60/0/0)	χ^2 = 17.33
Wilson weight (0/1/2) (%)	4/10/6*	16/0/4	<0.0001
	(20/50/30)	(80/0/20)	χ^2 = 17.60
Wilson head and neck movement (0/1) (%)	10/10	16/4	0.047
	(50/50)	(80/20)	χ^2 = 3.956
Wilson chin movement (0/1/2)	14/4/2 (70/20/10)	16/4/0 (80/20/0)	0.344
Wilson receding chin (0/1/2)	18/0/2 (90/0/10)	20/0/0 (100/0/0)	0.244
Wilson prominent canine (0/1/2)	18/2/0 (90/10/0)	20/0/0 (100/0/0)	0.244
A line joining the angle of the mouth and tragus of the ear with the horizontal (1/2)	12/8*	20/0	0.043
	(60/40)	(100/0)	χ^2 = 5.00
sternomental distance (cm)	11.35 ± 3.42*	14.10 ± 2.53	0.007
Tyromental distance (cm)	6.35 ± 1.34*	7.20 ± 1.20	0.041
Intubation attempts/reintubation (n) 1/2/3 or more	16/3/1 (80/15/5)	19/1/0 (95/5/0)	0.323

*$P < 0.05$, Comparison with Group C

Table 7: Direct laryngoscopic grading according to the modified Cormach and Lehane grading (*n*, %)

Direct laryngoscopic view	Group O (*n* = 20)	Group C (*n* = 20)	*P* values
Full view of glottis	2 (10)	14 (70)	<0.0001*
Only posterior commissure is visible	10 (50)	6 (30)	χ^2 = 18.000
Only the tip of epiglottis is visible	6 (30)	0 (0)	
No glottic structure is visible	2 (10)	0 (0)	

*$P < 0.05$: comparison with Group C

Table 8: Recovery parameters (mean ± SD)

Recovery parameters	Group O (*n* = 20)	Group C (*n* = 20)	*P*
Eye opening (min)	5.3 ± 3.4	4.0 ± 1.6	0.575
Response to the verbal stimulus (min)	7.4 ± 4.0	6.0 ± 1.6	0.305
Name saying (min)	8.8 ± 5.6	8.4 ± 2.4	0.898
Saying the date of birth (min)	9.1 ± 5.5	8.7 ± 4.8	0.901
Up lifting the arm (min)	6.8 ± 4.1	6.1 ± 1.8	0.605
Up lifting the leg (min)	7.0 ± 4.1	6.1 ± 1.8	0.574

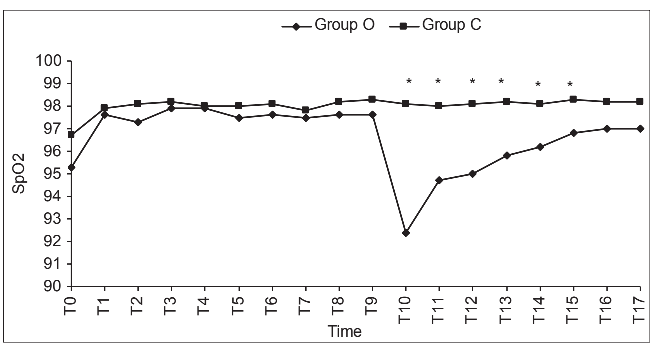

Figure 1: Time dependent saturation of oxygen (SpO_2) values in groups *$P < 0.05$: Comparison with Group C

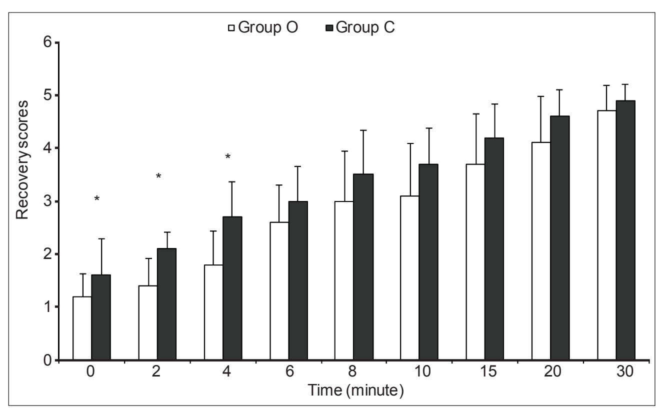

Figure 2: Recovery scores of the patients (Mean ± SD) *$P < 0.05$: Comparison with Group C

One of the contributing factors that affects post-anesthetic complication not related to anesthesia, analgesia, or sedation is patient's position. For example supine position worsens airway obstruction in some patients with position-dependent apnea.[10] It is important especially for OSA patients. In our research, patients' positions were same in groups.

Obesity, short thick neck, nasal obstruction, tonsillar hypertrophy, narrow oro-pharynx, and retrognathia are characteristic stigmatas of OSA. But these are not the diagnostic criteria of DI. On the other hand, some patients with OSA exhibit no specific predictors on routine examination.[2,11,12] In our research, DI parameters (BMI, Mallampati Scores, Wilson weight scores, sternomental, tyromental distance) showed significant correlation with DI in OSA patients.

DI is an important problem for induction period of the general anesthesia. Juvin *et al*[5] concluded that DI ratio was 2.2% in lean and 15.5% in obese patients respectively. Obesity is significantly related to OSA,[7,9] and DI is especially frequent in OSAS patients.[13,14] In our research, BMI was greater in Group O than in Group C.

Siyam *et al*.[14] performed a retrospective case control study to determine the incidence of DI in sleep apnea syndrome (SAS) patients and to determine the relationship between the severity of SAS and the occurrence of DI. In this research DI ratio was 21.9% in SAS and 2.6% in control group. They reported that SAS is a risk factor for DI but severity of the SAS was not related to DI. On the other hands, Neligan *et al*[15] reported that in morbidly obese patients there was no relationship between the presence and severity of OSA, BMI, or neck circumference and difficulty of intubation or laryngoscopy grade. Only a Mallampati score of 3 or 4 and male gender predicted DI. They concluded DI and difficult laryngoscopy rate in morbidly obese patients were 3.3 and 8.3% respectively. In our research, al though number of the intubation attempts was different in groups it was statistically insignificant ($P = 0.323$).

Lee *et al*[16] investigated the correlation of DI between age, height, weight, BMI, Epwort sleepiness scale, apnea-hypopnea index (AHI) in OSA patients. And they concluded that a high AHI and large neck circumference can predict DI. In our research, AHI was measured before operation in OSAS patients, but AHI score was not graduated. Therefore, correlation with AHI scores and difficult intubation was not researched.

Perioperative monitoring for apnea, desaturation and dysrhythmia is essential during anesthetic management of OSA patients. Postoperative period is particularly critical for OSA patients recovering from general anesthesia. They are at high risk of hypoxemia, and its possible consequences of cardiac and cerebral dysfunction.[1,16] In our research, SpO_2 values were significantly lower during early postoperative period in OSA patients. But we did not come across any serious complication.

When caring for the patient with OSA undergoing sedation or general anesthesia, careful monitoring of operative and postoperative period is mandatory. Pulse oximetry, blood pressure, $EtCO_2$ monitoring should be used. Emergency resuscitation equipment including invasive airway devices, ECG, defibrillator, emergent cardiac medication should be handled easily.

Moreover, nearly fatal respiratory complication and even unexpected deaths have been reported after surgery in patients with serious OSA that has been unrecognized or inadequately treated in the perioperative and postoperative periods.[10-12,17] Patients with OSA should be observed for at least 1 h in a recovery area after sedation or general anesthesia. Other minimum criteria for discharge include the following: easily arouse, full orientation, the ability to maintain and protect airway, stable vital signs for at least 30-60 min, and the ability to call for help if necessary.[10,17] In our research, patients were observed until they are ready for discharge.

Limitations of our study include the following: AHI scores were not graduated. Therefore, correlation with AHI scores and DI was not researched. Also, we did not measure neck circumference and calculate the sample size for postulating DI probability.

To conclude, DI is more in OSA patients than in non-OSA patients, according to BMI, Mallampati grading, Wilson weight scores, Laryngoscopic grading (Cormach and Lehane), sternomental distance, and tyromental distance

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