

The prevalence of perioperative complications in patients with obstructive sleep apnea versus without obstructive sleep apnea

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Abstract

Background: Patients with obstructive sleep apnea (OSA) have high risk of postoperative complications. The purpose of the study was to record the spectrum and frequency of postoperative complications in patients with OSA *versus* (vs.) without OSA depending on the type of surgery and type of anesthesia in a large cohort of patients.

Material and methods: We conducted a prospective, descriptive study (n=400). Ethics Committee approval was obtained and written informed consent was signed. STOP-BANG screening questionnaire was used for OSA screening (71.5% - OSA [+]). Adverse events and complications were recorded postoperatively (AOS [+] vs. AOS [-]). Statistics: Chi square test.

Results: The highest rate of complications was found in patients who have undergone surgery on the abdominal cavity under general anaesthesia, AOS [+] vs. AOS [-]: cardiovascular [59.2%] vs. [9,9%], respiratory [13.4%] vs. [3.4%], stroke [0.4%] vs. [0.0%], prolonged awakening from anesthesia [1.9%] vs. [0.4%], postoperative fever [2.4%] vs. [1.4%], difficult orotracheal intubation [2.2%] vs. [0.4%], unscheduled transfer to the intensive care unit [3.9%] vs. [0.2%].

Conclusions: OSA [+] patients who underwent abdominal surgery under general anaesthesia had a higher rate of complications compared to OSA [-] patients, and also compared to patients who had undergone peripheral limb surgery. Surgery on the musculoskeletal system is much better tolerated by patients with OSA, suffering a lower number and range of events and postoperative complications. Thus, loco-regional anesthesia is considered a priority in patients with OSA.

Key words: obstructive sleep apnea, preoperative screening, postoperative complications.

Introduction

Obstructive sleep apnea (OSA) is the most common sleep disorder in the adult population [1-5]. Current estimates suggest that moderately severe OSA is present in approximately 11.4% of men and 4.7% of women [1, 2]. According to I. Fitze et al. (2011) [6], the incidence of moderate OSA has increased by approximately 8% in the last 5 years. Intense and persistent snoring, accompanied by shortness of breath, prolonged respiratory pauses, observed by family members [7], excessive daytime somnolence [8] are symptoms that characterized obstructive sleep apnea.

The prevalence of OSA is higher in patients presenting for surgery than in the general population [9]. A significant proportion of OSA patients presenting for surgery remain undiagnosed. Patients with OSA have a higher propensity for perioperative complications following surgery under general anesthesia, whether or not surgery on treatment of obstructive sleep apnea.

Skilled surgeons and anesthetists in particular, should be aware that obstructive sleep apnea often remains undiagnosed and, therefore, should be aware of possible perioperative complications in these patients. The purpose of this study was to determine the prevalence of perianaesthetic complications in patients with obstructive sleep apnea versus without obstructive sleep apnea, depending on the type of surgery (on musculoskeletal or abdominal cavity) and the anesthetic technique (general, loco-regional or neuraxial).

Material and methods

A prospective cohort study was performed on a group of 400 patients enrolled for elective surgery on musculoskeletal system or abdominal cavity, with total intravenous anaesthesia or loco-regional anesthesia. The study was conducted at the Department of Anesthesiology and Reanimatology of Valeriu Ghereg (Clinical base of the Institute of Emergency Medicine) between March 2014 and June 2015. In the research we included adult patients, aged between 29 and 82 years (mean age - 56 years). All patients signed written informed consent for study enrollment. Ethical approval for the study was obtained from the Research Ethics Committee of the State University of Medicine and Pharmacy "Nicolae Testemitanu".

STOP-BANG screening questionnaire was used for preoperative screening of patients. STOP-BANG questionnaire identifies patients with high risk of OSA [9]. Recently, the STOP-BANG questionnaire (snoring, daytime fatigue, observed episodes of apnea, high blood pressure, body mass index > 35 kg / m², age > 50 years, neck circumference > 40cm, male) was validated as a way for screening of OSA in the preoperative period [9]. This questionnaire contains 8 questions with answers "yes" or "no." Patients are considered at high risk if they give OSA ≥3 answers "yes". Therefore, if the patient is placed in the low risk category of obstructive sleep apnea by STOP-BANG, the doctor can exclude the possibility that the patient has obstructive

tive sleep apnea of moderate to severe degree, with a high degree of accuracy.

Postoperatively (until hospital discharge), all complications or adverse events that occurred, of any origin, were recorded. Additionally, we recorded all demographic parameters, the type of surgery and anesthetic technique used. The type of anesthesia was chosen depending on the patient's physiological state and surgery.

Depending on the score obtained in each questionnaire, the cohort of 400 patients was divided into "high-risk patients of OSA" (OSA [+]) and "patients without risk of OSA" (OSA [-]). For each group of patients, OSA [+] or OSA [-], postoperative complications were recorded: cardiovascular (hypertension, hypotension, cardiovascular instability, cardiac arrhythmia, myocardial infarction); respiratory (respiratory failure, need for postoperative artificial ventilation of the lungs over 60 minutes, pneumonia, laryngospasm); other adverse events and complications (unplanned transfer to ICU, difficult intubation, stroke, postoperative fever [higher than 38.5 °C]). Hypertension was defined as an increase in systolic blood pressure $\geq 25\%$ from baseline for a period of minimum 5 minutes. Hypotension was defined as a decrease in systolic blood pressure ≤ 90 mm Hg for a period of minimum 5 minutes. All adverse events and complications were recorded until hospital discharge.

Primary results of the questionnaires were recorded in Microsoft Excel table. The statistical analysis was performed with GraphPad Prism 4 software (Version 4.00) for statistical analysis (GraphPad Software, San Diego, California, USA). Statistics was performed by Chi square test and Fisher test. Results are presented as absolute and relative value (binary data) or as mean and confidence interval of 95% (continuous data).

Results

Patients' characteristics and factors of increased risk for obstructive sleep apnea in the OSA [+] and OSA [-] groups

Table 1

The general characteristics of patients according to increased or decreased risk of OSA

Parameters	OSA+ (n=286)	OSA- (n=114)	p
Age, years	57.8 (56.8-58.9)	51.7 (50.0-53.4)	0.0001
Men, n (%)	107 (37.4%)	25 (21.9%)	0.0001
Height, cm	167.5 (166.5-168.7)	166.0 (164.6-167.6)	0.13
Body mass, kg	90.2 (88.1-92.1)	75.3 (72.6-77.0)	0.0001
BMI [†] , kg/m ²	32.2 (31.5-32.9)	27.3 (26.6-29.1)	0,0001
Mallampati stage I-II III-IV	148 (37%) 138 (34.5%)	81 (20.2%) 33 (11.9%)	0,0001
Presence /Absence of comorbidities	236 (59%)/ 50 (12.5%)	57 (14.2%)/ 57 (14.2%)	0,0001

Note: for continuous data, results are presented as the mean and confidence interval 95%; for binary data, results are presented as absolute and relative terms. [†] – body mass index.

are presented in table 1.

Comorbidities detected in patients enrolled in the research were: hypertension, heart failure, myocardial infarction, ischemic heart disease, atrial fibrillation, dysrhythmia, diabetes, asthma, stroke, hypothyroidism and others.

Using STOP-BANG screening questionnaire for OSA, we determined that from 400 patients, 286 patients are in the category of high risk for obstructive sleep apnea (OSA [+]) and only 114 patients are in the low risk category (OSA [-]). The total number of recorded complications was 401, of which, according to the questionnaire, patients with OSA [+] manifested a total number of 337 complications (83.83%), while OSA [-] patients showed a total of 65 (16.16%), confirming that patients with OSA [+] are at high risk of postoperative complications and adverse events (table 2).

Table 2

Distribution of postoperative complications and adverse events after Berlin questionnaire

Complications and adverse events	Number of complications OSA [+] group	Number of complications OSA [-]group	Total number of complications	p
Cardiovascular	238 (59.2%)	40 (9.9%)	278	0,0001
Respiratory	54 (13.4%)	14 (3.4%)	68	0,0001
UT ICU [†]	16 (3.9%)	1 (0.2%)	17	0,0002
Difficult OTI [‡]	9 (2.2%)	2 (0.4%)	11	0,06
Prolonged awakening from anesthesia	8 (1.9%)	2 (0.4%)	10	0,1
Stroke	2 (0.4%)	0 (0%)	2	0,4
Postoperative fever	10 (2.4%)	6 (1.4%)	16	0,4
Total number of complications	337	65	402	

Note: [†] – unplanned transfer to Intensive Care Unit; [‡] – difficult oro-tracheal intubation;

We made a comparative analysis between lots to determine postoperative complications and adverse events depending on the type of surgery and anaesthesia (tables 4 and 5). The highest number of complications was recorded in the OSA [+] undergoing abdominal surgery. The prevalence of complications was higher in OSA [+] patients who underwent abdominal surgery under general anaesthesia compared to OSA [-] who underwent abdominal surgery under general anaesthesia (147 versus 52, $p < 0.0001$) (table 3). Similarly, the prevalence of complications was higher in OSA [+] undergoing peripheral limb surgery compared to OSA [-] patients (123 versus 53, $p < 0.0001$) (table 4).

OSA [+] patients who underwent abdominal surgery under general anaesthesia had a higher rate of cardiovas-

cular and respiratory complications compared to OSA [-] patients, and also higher cardiovascular complications compared to patients who had undergone peripheral limb surgery under regional anaesthesia (tables 3 and 4).

Discussion

The results of the present study showed that patients with OSA syndrome are at higher risk to present complications after abdominal surgery under general anaesthesia compared to patients who do not present this syndrome. OSA [+] patients tolerate better the neuraxial musculoskeletal surgery under regional anaesthesia.

This is because the obstructive sleep apnea syndrome is characterized by frequent episodes of interrupted breath-

Table 3

Postoperative complications and adverse events in patients with surgery on abdominal cavity

	OSA [+]	OSA [-]	Total	p
Surgery on abdominal cavity	163	61	224	0.0001
General anaesthesia	147	52	199	0.0001
Total cardiovascular complications	150 (54.1%)	27 (9.7%)	177	0.0001
Hypertension	104 (58.7%)	23 (12.9%)	127	
Hypotension	16 (9.03%)	0 (0%)	16	
Hemodynamic instability	4 (2.2%)	0 (0%)	4	
Cardiac dysrhythmia	25 (14.1%)	4 (2.2%)	29	
Myocardial infarction	1 (0.5%)	0 (0%)	1	
Total respiratory complications	49 (17.6%)	10 (3.5%)	59	0.0001
Respiratory depression	30 (50.8%)	8 (13.5%)	38	
Need for postoperative ventilation	14 (23.7%)	1 (1.6%)	15	
Pneumonia	3 (5.08%)	1 (1.6%)	4	
Laryngospasm	2 (3.3%)	0 (0%)	2	
Unplanned transfer to ICU	15 (5.4%)	1 (0.3%)	16	0.0005
Difficult intubation	9 (3.2%)	2 (0.7%)	11	0.06
Prolonged awakening from anaesthesia	5 (1.8%)	2 (0.7%)	7	0.4
Stroke	2 (0.7%)	0 (0%)	2	0.4
Postoperative fever	4 (1.4%)	1 (0.3%)	5	0.3
Neuraxial anaesthesia	16	9	25	0.2
Total cardiovascular complications	9 (75%)	3 (25%)	12	0.1
Hypertension	6 (50%)	0 (0%)	6	
Hypotension	1 (8.3%)	1 (8.3%)	2	
Hemodynamic instability	1 (8.3%)	1 (8.3%)	2	
Cardiac arrhythmia	1 (8.3%)	1 (8.3%)	2	
Myocardial infarction	0 (0%)	0 (0%)	0	
Total respiratory complications	0 (0%)	0 (0%)	0	-
Respiratory depression	0 (0%)	0 (0%)	0	
Need for postoperative ventilation	0 (0%)	0 (0%)	0	
Pneumonia	0 (0%)	0 (0%)	0	
Laryngospasm	0 (0%)	0 (0%)	0	
Unplanned transfer to ICU	0 (0%)	0 (0%)	0	-
Difficult intubation	0 (0%)	0 (0%)	0	-
Prolonged awakening from anaesthesia	0 (0%)	0 (0%)	0	-
Stroke	0 (0%)	0 (0%)	0	-
Postoperative fever	0 (0%)	0 (0%)	0	-

Table 4

Postoperative complications and adverse events in patients with surgery on musculoskeletal system

	OSA [+]	OSA [-]	Total	p
Surgery on musculoskeletal system	123	53	176	0.0001
General anaesthesia	9	9	18	1.0
<u>Total cardiovascular complications</u>	<u>11 (45.8%)</u>	<u>2 (8.3%)</u>	<u>13</u>	<u>0.02</u>
Hypertension	6 (46.1%)	1 (7.6%)	7	
Hypotension	3 (23.07%)	1 (7.6%)	4	
Hemodynamic instability	0 (0%)	0 (0%)	0	
Cardiac arrhythmia	2 (15.3%)	0 (0%)	2	
Myocardial infarction	0 (0%)	0 (0%)	0	
<u>Total respiratory complications</u>	<u>2 (8.3%)</u>	<u>3 (12.5%)</u>	<u>5</u>	<u>1.0</u>
Respiratory depression	0 (0%)	3 (60%)	3	
Need for postoperative ventilation	1 (20%)	0 (0%)	1	
Pneumonia	1 (20%)	0 (0%)	1	
Laryngospasm	0 (0%)	0 (0%)	0	
Unplanned transfer to ICU	1 (4.1%)	0 (0%)	1	1.0
Difficult intubation	0 (0%)	0 (0%)	0	-
Prolonged awakening from anesthesia	3 (12.5%)	0 (0%)	3	0.2
Stroke	0 (0%)	0 (0%)	0	-
Postoperative fever	0 (0%)	2 (8.3%)	2	0.1
Neuraxial anaesthesia	98	39	137	0.0001
<u>Total cardiovascular complications</u>	<u>60 (81.08%)</u>	<u>7 (9.4%)</u>	<u>67</u>	<u>0.0001</u>
Hypertension	11 (16.4%)	0 (0%)	11	
Hypotension	25 (37.3%)	4 (5.9%)	29	
Hemodynamic instability	11 (16.4%)	2 (2.9%)	13	
Cardiac arrhythmia	11 (16.4%)	1 (1.4%)	12	
Myocardial infarction	2 (12.9%)	0 (0%)	2	
<u>Total respiratory complications</u>	<u>1 (1.3%)</u>	<u>0 (0%)</u>	<u>1</u>	<u>1.0</u>
Respiratory depression	0 (0%)	0 (0%)	0	
Need for postoperative ventilation	0 (0%)	0 (0%)	0	
Pneumonia	1 (100%)	0 (0%)	1	
Laryngospasm	0 (0%)	0 (0%)	0	
Unplanned transfer to ICU	0 (0%)	0 (0%)	0	-
Difficult intubation	0 (0%)	0 (0%)	0	-
Prolonged awakening from anesthesia	0 (0%)	0 (0%)	0	-
Stroke	0 (0%)	0 (0%)	0	-
Postoperative fever	5 (6.7%)	1 (1.3%)	6	0.2
Peripheral nerve blocks	16	5	21	0.02
<u>Total cardiovascular complications</u>	<u>9 (75%)</u>	<u>1 (8.3%)</u>	<u>10</u>	<u>0.02</u>
Hypertension	6 (60%)	1 (10%)	7	
Hypotension	0 (0%)	0 (0%)	0	
Hemodynamic instability	0 (0%)	0 (0%)	0	
Cardiac arrhythmia	3 (30%)	0 (0%)	3	
Myocardial infarction	0 (0%)	0 (0%)	0	
<u>Total respiratory complications</u>	<u>0 (0%)</u>	<u>1 (8.3)</u>	<u>1</u>	<u>1.0</u>
Respiratory depression	0 (0%)	0 (0%)	0	
Need for postoperative ventilation	0 (0%)	0 (0%)	0	
Pneumonia	0 (0%)	1 (100%)	1	
Laryngospasm	0 (0%)	0 (0%)	0	
Unplanned transfer to ICU	0 (0%)	0 (0%)	0	-
Difficult intubation	0 (0%)	0 (0%)	0	-
Prolonged awakening from anesthesia	0 (0%)	0 (0%)	0	-
Stroke	0 (0%)	0 (0%)	0	-
Postoperative fever	0 (0%)	1 (8.3%)	1	1.0

ing during sleep, due to the recurrent obstruction of the upper airways. Despite these anomalies apnea doesn't occur during wakefulness, which indicates the existence of functional pathology on the control of breathing during sleep. A big tendency of upper airway collapse is characteristic to sleep apnea like during anesthesia. These episodes usually occur when the negative pressure of inspiratory muscles exceeds the upper airway dilator muscle activity (critical airway pressure) [10, 11]. General anesthetics have been shown to decrease the upper airway dilator muscle activity in a dose-dependent manner and thereby increase upper airway collapsibility [12]. Upper airway collapsibility may cause worsening of the sleep apnea and increase the risk of hypoxemia and cardiac arrhythmias, and postoperative complications.

The risk of perioperative complications depends on ASA (American Society of Anesthesiologists) class [13], age [14], emergency surgery, cardiac comorbidities [15], smoking [16], duration of surgery [17], type of anesthesia [18], as well as on the presence of comorbidities like chronic obstructive pulmonary disease, coronary artery disease, and renal failure [19]. The risk of postoperative complications depends also on the type of surgery, the rate of complications being higher in patients operated on abdomen [20].

Anesthetic medicines also impair the arousal response, a protective defense mechanism against sleep apnea that helps in overcoming the airway obstruction. Anesthetics, opioids, hypnotics, and benzodiazepines may also cause respiratory depression and thereby decrease the minute ventilation. Studies have shown that halothane reduces the ventilatory response to hypoxemia and hypercapnia [21]. This depression is most likely secondary to a selective effect of halothane on the peripheral chemoreflex loop. Similarly, a subanesthetic dose of isoflurane has been shown to reduce the hypoxic ventilatory response via peripheral chemoreceptors [22].

Patients undergoing surgery frequently receive opioids for the pain control. Opioids have been shown to impair ventilatory function by affecting both peripheral and central carbon dioxide chemoreflex loops [23].

Similar to our research, R. Gupta et al. (2001) have shown an increased risk of postoperative complications (39% vs. 18%), a higher rate of transfer to Intensive Care Unit (24% vs. 9%) and increased length of hospital stay in patients with OSA, compared with control subjects matched for age, sex and body mass index (BMI) [24]. In another case-control study, P. Liao et al. (2009) found that patients with OSA had higher rate of postoperative complications (44% vs. 28%) [25]. R. Kaw et al. (2006) also demonstrated that patients with OSA had higher incidence of encephalopathy, postoperative infections (mediastinitis), and increased length of stay [26].

A recent retrospective cohort study on 18,000 adult pa-

tients, who suffered fracture of the femoral neck, showed that those anesthetized with neuro-axial block, compared with those with general anesthesia, have decreased rate of pulmonary and cardiovascular postoperative complications and decreased mortality by 25-29% [27].

Besides abolishing stimulatory effects of awakening, these include depression of hypoxic and hypercapnic response [28], request of compensation reflexes [29] and the response of excitement that normally protects against asphyxia. The same like in sleep, appears skeletal muscle tone depression with reduction of residual functional capacity, which predispose to atelectasis and upper airway muscle relaxation, which predisposes to obstruction. These effects are compounded by the reduction in phasic activity of the intercostal and accessory respiratory muscles, growing dependence of the diaphragm and the muscles of the upper airway during inspiration, further predisposing to airway obstruction [30].

The presence of a vigilant anesthesiologist, able to monitor and maintain vital functions during anesthesia, defends the patient to these effects. However, induced drug sedation and postanesthetic sleepiness, where the boundaries between wakefulness, sleep and anesthesia are less distinct, and a monitoring less rigorous, presents a potential danger for a patient with a disorder of breathing during sleep due to depression of these responses.

OSA is associated with a number of medical comorbidities including hypertension, heart failure, myocardial infarction, diabetes mellitus, gastroesophageal reflux disease, and stroke [31].

The limit of our study consists in the fact that STOP-BANG questionnaire is a screening tool aimed to identify the patients at risk for OSA [9]. This does not mean that the patients actually had OSA, as the diagnosis needs confirmation by polysomnography, which is the gold standard test to establish definitive diagnosis. However, STOP-BANG screening questionnaire is an instrument easy to use, which was validated for the preoperative assessment of patients [9].

Conclusions

1. Obstructive sleep apnea syndrome is a common type of sleep disordered breathing, with a high prevalence in the surgical population. In our study, the prevalence of OSA was 71.5%, as assessed by using the STOP-BANG screening questionnaire.
2. The majorities of patients with sleep apnea are undiagnosed and are therefore unaware of their OSA syndrome at the time of surgery. OSA [+] patients presented higher incidences of postoperative complications compared to OSA [-] patients.
3. Surgery and anaesthesia have been shown to cause worsening of sleep apnea in the perioperative period

that may lead to increase in the rate of perioperative complications. The type of surgery, as well as the type of anaesthesia, is independent risk factors for the occurrence of postoperative complications.

4. Loco-regional anesthesia represents a priority for patients at high risk for obstructive sleep apnea.

Declaration of conflicting interests

Authors declare no financial or non-financial conflicts of interest.

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