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RESEARCH ARTICLE / ÖZGÜN ARAŞTIRMA

Application Value of the screening questionnaires to predict OSA-related complications following thoracic surgery for lung cancer

Akciğer Kanseri Cerrahisi Sonrası Obstrüktif Uyku Apne ile İlişkili Komplikasyonları Öngörmede Tarama Anketlerinin Uygulama Değeri

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ABSTRACT

Objective: The objective of this study was to investigate whether or not sleep apnea screening questionnaires including STOP-BANG, Berlin, and NoSAS, predict obstructive sleep apnea (OSA)-related complications following thoracic surgery for lung cancer.

Material and Methods: This was a prospective study. Patients with a diagnosis of lung cancer who were eligible for elective thoracic surgery were enrolled in the study between July 1, 2016, and July 1, 2017. All patients underwent pre-operative pulmonary evaluations and completed the STOP-BANG and Berlin questionnaires. The NoSAS score was subsequently calculated. The relationship between post-operative OSA-related complications and screening questionnaires was assessed.

Results: Of 71 patients enrolled, 58 (81.70%) had a STOP-BANG score of ≥3, 27 (38%) had a Berlin questionnaire score of ≥2, and 53 (74.60%) had a NoSAS score of ≥8. Of the 71 patients, 27 (38%) had OSA-related complications. There were no statistically significant differences between the patient groups with and without OSA-related complications in terms of STOP-BANG (p=0.586), Berlin (p=0.586), or NoSAS (p=0.799) scores. However, 21 (77.6%) of the 27 patients with OSA-related complications were at high-risk for OSA according to the STOP-BANG and NoSAS score.

Conclusion: Neither the STOP-BANG or Berlin questionnaires nor the NoSAS scores were helpful as predictors of OSA-related complications following thoracic surgery for lung cancer. However, in view of the high prevalence of sleep apnea in patients with lung cancer, screening for OSA in this population remains a useful, high yield pursuit. The NoSAS score may be an appealing candidate due to its simplicity and use of objective parameters.

Keywords: Lung cancer, obstructive sleep apnea, screening questionnaires, thoracic surgery.

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ÖZ

Amaç: Çalışmanın amacı, akciğer kanseri torasik cerrahisi sonrasında obstrüktif uyku apne (OUA) ile ilişkili komplikasyonları öngörmede STOP-BANG, Berlin ve NoSAS skoru dahil uyku apnesi tarama anketlerinin değerini araştırmaktır.

Gereç ve Yöntemler: Bu çalışma, prospektif bir çalışmadır. Elektif torasik cerrahi endikasyonu olan akciğer kanseri tanılı hastalar 1 Temmuz 2016 ile 1 Temmuz 2017 tarihleri arasında çalışmaya alındı. Tüm hastalara ameliyat öncesi pulmoner değerlendirme yapıldı. STOP-BANG ve Berlin anketleri uygulandı. NoSAS skoru hesaplandı. Postoperatif OUA ile ilişkili komplikasyonlar ile tarama anketleri skorları arasındaki ilişki değerlendirildi.

Bulgular: Çalışmaya 71 hasta kabul edildi. Elli sekiz (%81,7) hastanın STOP-BANG skoru ≥3, 27 (%38) hastanın Berlin anket skoru ≥2 ve 53 (%74,6) hastanın NoSAS skoru 8 olarak tespit edildi. Yetmiş bir hastanın 27 (%38)'sinde OUA ile ilişkili komplikasyon belirlendi. OUA ile ilişkili komplikasyonları olan ve olmayan hasta grupları arasında STOP-BANG (p=0,586), Berlin (p=0,586) ve NoSAS (p=0,799) skorları açısından istatistiksel olarak anlamlı farklılık tespit edilmedi. Ancak, OUA ile ilişkili komplikasyonları olan 27 hastanın 21'inin (%77,6) STOP-BANG ve NoSAS skoruna göre, OUA için yüksek risk grubunda olduğu belirlendi.

Sonuç: STOP-BANG anketi, Berlin anketi ve NoSAS skoru, akciğer kanseri için torasik cerrahiyi takiben gelişebilecek OUA ile ilişkili komplikasyonları öngörmede yardımcı olmadı. Bununla birlikte, akciğer kanserli hastalarda uyku apnesinin yüksek prevalansı göz önünde bulundurulduğunda, bu popülasyonda OUA taramasının yararlı ve yüksek verimli bir uygulama olduğunu düşünmekteyiz. NoSAS skoru, basitliği ve objektif parametrelerin kullanımı nedeniyle bu amaç için uygun bir aday olabilir.

Anahtar kelimeler: Akciğer kanseri, obstrüktif uyku apnesi, tarama anketleri, göğüs cerrahisi.

INTRODUCTION

Obstructive sleep apnea (OSA) is a major public health problem with estimated prevalence rates of 22% in men and 17% in women.[1] OSA is characterized by complete and partial obstruction of the upper airway during sleep, leading to intermittent hypoxia and sleep fragmentations. Endothelial dysfunction, systemic inflammation, and oxidative stress are the well-described features of OSA associated with metabolic and cardiovascular consequences[2,3] Furthermore, the recognition of recurrent nocturnal hypoxemia, sleep fragmentation, systemic inflammation, and oxidative stress, which contributes to the development of oncogenic milieu, has led to studies exploring the relation between cancer and sleep apnea.[4] The association between sleep apnea, nocturnal hypoxemia, and cancer may be particularly important for tobacco-related cancers like lung cancer, in which hypoxia may play an influential role in carcinogenesis.[5] A recently published study revealed that nocturnal hypoxemia and sleep apnea were highly prevalent in patients with lung cancer.[6]

Surgical resections ensure the highest possibility of cure in the early-stage disease in eligible patients. However, surgical interventions may lead to post-operative complications.[7] Following lung cancer surgery, the risk of post-operative complications ranges from 6.7% to 50%.[8] Studies revealed that OSA is related with an increased risk of post-operative complications in the surgical setting.[9] Among elective surgery candidates, the prevalence of OSA is assessed to be at least 25%.[10] The American Society of Anesthesiologists and the Society of Anesthesia and Sleep Medicine strongly recommend screening for OSA in the pre-operative period, because the majority of surgical patients are undiagnosed.[11,12] At the present time, full-night polysomnography examination is the gold standard for diagnosing OSA. However, the procedure is relatively inaccessible, expensive, time-consuming, and complex and requires technical personnel.[13] Pre-operative questionnaires for predicting high-risk patients for OSA have been previously used in the pre-operative periods of numerous types of surgical interventions. In the surgical population, STOP-BANG questionnaire and the Berlin questionnaire have been validated and are the most used OSA screening surveys.[12] NoSAS is a lately developed screening tool that is used to recognize patients with an increased risk for sleep-disordered breathing (SDB).[14]

Considering the increased prevalence of sleep apnea in patients with lung cancer and the relation between OSA and post-operative complications, it is important to evaluate patients with lung cancer for possible OSA before thoracic surgery. In this study, we aimed to investigate whether sleep apnea screening questionnaires including STOP-BANG, Berlin, and NoSAS, which are used to describe sleep apnea risk, would also predict OSA-related complications following thoracic surgery for lung cancer.

MATERIAL AND METHODS

Subjects

This was a prospective cross-sectional study. Patients with a diagnosis of lung cancer who were eligible for elective thoracic surgery were enrolled in the study between July 1, 2016, and July 1, 2017. Patients with an inability to complete questionnaires and patients with a previous diagnosis of SDB were excluded from the study. Unfortunately, one patient died of pre-operative complications and was, therefore, excluded from the analysis (Fig. 1).

Routine pre-operative evaluations of all patients who agreed to participate in the study were performed. Arterial blood gases and pulmonary function tests were evaluated. Smoking habits and history of chronic illness of all patients were recorded. Neck circumferences were measured and body mass index (BMI) calculated. In addition to the routine procedure, patients were asked to complete the Berlin and STOP-BANG questionnaires. The NoSAS score was subsequently calculated from the existing data of the patients. The results of the questionnaires were kept separately from the other medical data. Surgical team members and intensive care unit (ICU) physicians were blinded to the results of the STOP-BANG, Berlin, and the NoSAS scores.

Screening Tools

The STOP-BANG questionnaire consists of eight dichotomous (yes/no) questions. Four of the questions are subjective (STOP: Snoring, tiredness, observed apnea, and high blood pressure) and four of demographic (BANG: BMI >35 kg/m^2, age >50 years, neck circumference >40 cm, male gender). Total score ranges from 0 to 8. High risk for SDB is regarded as answering yes to three or more question.[15]

The Berlin Questionnaire consists of ten questions arranged in three categories. There are five questions about snoring in the first category. The second category includes three questions about fatigue and daytime sleepiness. The last category includes data about the obesity and systemic arterial hypertension. The total Berlin Questionnaire score is calculated from the answers to the three categories: the first two categories are evaluated depending on the responses signify. It is considered positive if the frequent symptoms (>3–4 times/week) on two or more questionnaire items. The third category is regarded positive in the presence of hypertension or a BMI >30 kg/m^2. To have, a positive score on two or more categories are classified as high risk for OSA.[16]

The NoSAS score is a recently developed screening toll. This score ranges from 0 to 17. NoSAS score parameters are as follows: Four points for a neck circumference ≥40 cm, three points for a BMI ≥25 kg/m² to <30 kg/m² or five points for a BMI >30 kg/m², two points for snoring, four points for age >55 years old, and two points for being male. The NoSAS score of 8 or higher defines a high risk for SDB.[14]

Anesthesia and Surgical Procedure

In the operating room, the patients' electrocardiogram, invasive arterial blood pressure, and peripheral oxygen saturation were monitored. Venous access was used for the medications. For the post-operative analgesic medication, a thoracic epidural catheter was inserted. Anesthesia induction and muscle relaxation were achieved using 0.5–1 mg atropine, 0.5–1 mg/kg lidocaine, 2–3 mg/kg propofol, 0.6 mg/kg rocuronium, and 2–20 mcg/kg fentanyl.

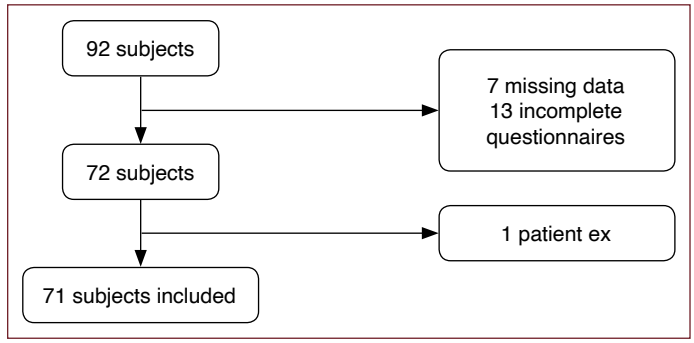

Figure 1: Flow chart.

Following the anesthesia protocol, single-lung ventilation was achieved using double-lumen intubation tubes. Intravenous maintenance of anesthesia was achieved using 4–12 mg/kg/hour propofol, 0.025–2 mcg/kg/min remifentanil. The patient was placed in the lateral thoracotomy position. Either thoracotomy or video-thoracoscopic exploration was performed according to the size of the tumor, and the BMI of the patient. In video-thoracoscopy, a utility incision at the fourth intercostal space was used accompanying a camera port. Standard posterolateral thoracotomy from the fifth intercostal space was used for patients undergoing thoracotomy. All resection procedures and lymph node dissections were performed in the same way for both surgical methods. In case of necessity-ensuring R0 resection-wedge resection, chest wall resection, and vascular resections were added. The above-mentioned interventions were considered as additional surgical procedures. One or two chest drains were inserted to the pleural space depending on the type of surgery. Chest drains were removed post-operatively when pleural drainage was under 200 cc/day and air leaks ended.

Patients were taken to the ICU after surgery. In the ICU, the patients' electrocardiogram, peripheral oxygen saturation, and invasive arterial blood pressure were monitored. All patients were given nasal oxygen supplementation in the ICU.

Patients were accepted eligible for ICU discharge when they met the following criteria: No active chest tube drainage, no arrhythmia, no need for vasopressors or inotropic agents, normal arterial blood pressure, saturation of oxygen higher than 90%, and good mental status.

Patients were discharged from the hospital at the day of chest drain removal or after use of the Heimlich valve system for air leak were discontinued. Indications for chest tube removal were full lung expansion, a drainage lower than 200 ml/day, and no air leak.

Complication Assessment

Three separate forms were prepared for the assessment of complications. In the first form (form-1), pre-anesthetic assessment, American Society of Anesthesiologist, and Mallampati scores were noted. Complications during intubation were noted as yes-no (difficult intubation, difficult face mask ventilation during intubation, desaturation, coughing, vomiting, aspiration, and bronchospasm). Intraoperative and extubation complications were noted on form-1.

After patients were taken to the ICU, form-2 was used for ICU follow-up. Arterial blood gas was taken from the patients 1 h after they were admitted to the ICU. According to the results, we recorded whether or not there was hypoxia, hypercapnia, or oxygen desaturation. Cardiac and respiratory monitoring was performed. Non-invasive and/or invasive mechanical ventilation requirement, pulmonary edema, and development of acute respiratory distress syndrome were recorded. The Ramsey sedation score and visual analog scores were completed nurses for assessments. The duration of stay in the ICU and blood gas values measured before discharge was noted. Additional complications were recorded.

After the patients were transferred to the ward, form-3 was used. Atelectasis, pneumonia, effusion, prolonged air leakage, pneumothorax, bleeding, transfusion requirement, bleeding, effusion, bronchopleural fistula, sepsis, and incision-related complications were recorded. The number of days spent in hospital was recorded. Perioperative and post-operative follow-up of the patients were performed by the ICU physicians and members of the surgical team.

Statistical Analysis

The data were analyzed using the IBM-SPSS 25.0 package. Crossed tables were prepared for the comparison between the groups and the Chi-square test was used for categorical data. Normal distribution of numeric variables was checked using the Shapiro-Wilk test. Comparisons were made between two groups using the t-test, and comparisons between 3 groups were performed using analysis of variance (ANOVA). If the ANOVA result was significant, pair-wise comparisons were performed using the least significant test with Bonferroni correction. The Mann-Whitney test was used to compare two groups without normal distribution. $P<0.05$ was accepted as statistical significance. Categorical data are expressed as number and percentage. Numerical data are expressed as mean and standard deviation if they had normal distribution and as median, with minimum and maximum if they had non-normal distribution.

The study was approved by the Local Research Ethics Committee (Date: 30.06.2016, Number:1389). Informed consent was obtained from all individual participants included in the study.

RESULTS

Of 71 patients retained for analysis, 60 (84.50%) were men. The mean age of the study population was 61.96±8.66 years. The demographic features of the study population are demonstrated in Table 1. Lung function tests revealed the mean FEV_1 as 77.30±16.10%, FVC as 79.50±14.80%, and the FEV_1/FVC ratio as 78.08±9.70. The mean of the pre-operative arterial blood gas results was as follows; pH: 7.42±02, PO2: 84.8±11.40 mm Hg, PCO_2: 38.80±3.60 mm Hg, and oxygen saturation: 96.70±2.20%.

Forty-eight patients (67.60%) underwent lobectomy, 17 (23.90%) pneumonectomy, and 6 (8.50%) had bilobectomy. Sixteen of 71 patients underwent additional surgical procedures (thoracic wall resection [4.20%], wedge resection [14.10%], decortication [2.80%], and vena cava resection [1.40%]). Nineteen patients (26.80%) were diagnosed as having adenocarcinoma, 50 (70.40%) had squamous cell carcinoma, and 2 (2.80%) had carcinoid tumor.

Table 1: Demographic data of the study population (n=71)

	n	%
Age, year	61.96±8.63	
Gender		
Male	60	84.50
Female	11	15.50
BMI, kg/m^2	26.64±4.53	
Neck circumference, cm	39.54±3.77	
Smoker	68	95.70
Snoring	47	66.20
Witnessed apnea	17	23.90
Daytime sleepiness	26	36.60
Hypertension	26	36.60
Diabetes mellitus	14	19.70
COPD	13	18.30
Coronary artery disease	6	8.50
History of previous tuberculosis	4	5.60
ASA class		
1	4	5.60
2	60	84.50
3	7	9.90
Mallampati scores		
1	2	2.80
2	52	73.20
3	16	22.50
4	1	1.40

Data is depicted as mean±SD or number, percentage. BMI: Body mass index, COPD: Chronic obstructive pulmonary disease, ASA: American society of anesthesiologists.

Regarding the screening tools, 27 (38%) patients had a Berlin score of ≥2, 53 (74.60%) had a NoSAS score of ≥8, and 58 (81.70%) had a STOP-BANG score of ≥3. Complications that developed in the perioperative period were as follows: (1) pre-operative period-difficult endotracheal intubation (11%); (2) during the follow-up in the ICU-hypercapnia (28.20%), hypoxia (2.80%), non-invasive mechanical ventilation support (8.50%), and invasive mechanical ventilation support (2.80%), and (3) during the ward follow-up-atelectasis (12.70%), pneumonia (5.60%), hemothorax (2.80%), pneumothorax (4.20%), bleeding (21.10%), bronchopleural fistula (7%), effusion (7%), chylothorax (5.60%), and prolonged air leak (11.30%). In the perioperative period, 42% of patients needed a blood transfusion. Of the 71 patients, 48 (67.60%) had at least one of the complications previously mentioned above.

We considered OSA-related complications as difficult endotracheal intubation, hypoxemia, hypercapnia, need for non-invasive mechanical ventilation support, and invasive mechanical ventilation support. A total of 27 (38%) patients had OSA-related complications. Table 2 demonstrates the characteristics of the patients with and without OSA-related complications. The frequency of complications related with OSA was higher in women (p=0.02), patients with ade-

Table 2: Comparison of the groups with and without OSA-related complications

	Subjects with OSA-related complications		Subjects without OSA-related complications		p
	n	%	n	%	
Number	27	38	44	62	
Gender					**0.01**
Male	19	70.40	41	93.20	
Female	8	29.60	3	6.80	**0.01**
Age, year	61.64±10.23		62.12±7.65		0.826
BMI, kg/m^2	26.95±3.66		26.45±5.02		0.649
Neck circumference, cm	39.64±3.99		39.47±3.67		0.855
Smoke, p/y	54.07±32.40		54.98±22.92		0.891
Adeno Ca	11	40.7	8	18.2	**0.037**
Squamous cell Ca	15	55.6	35	79.5	**0.032**
Additional surgical procedure	10	37	6	13.60	**0.022**
NoSAS score	10.51±3.88		10.27±3.97		0.799
STOP-Bang score	3.81±1.33		4.00±1.41		0.586
Berlin score	1.26±1.05		1.14±0.82		0.586
NoSAS score ≥8	21	77.80	32	72.70	0.635
STOP-Bang ≥3	21	77.80	37	84.10	0.504
Berlin ≥2	11	40.70	16	36.40	0.712
ESS ≥10	2	7.40	4	9.10	0.804
ICU length of stay, hours	20.59±2.40		19.32±3.75		0.382
Time of discharge, days	7.34±3.21		6.90±2.56		0.525

Data is depicted as mean±SD or number, percentage. OSA: Obstructive sleep apnea, BMI: Body mass index, ESS: Epworth Sleepiness Scale; ICU: Intensive care unit.

nocarcinoma (p=0.037), and patients who needed additional surgical procedures, (p=0.02). There was no statistically significant difference between the groups regarding accompanying diseases and type of surgery performed (p>0.05). There was no difference between the groups with and without OSA-related complications in terms of STOP-BANG (p=0.586), Berlin (p=0.586), and NoSAS scores (p=0.799). However, 21 of 27 patients (78%) who developed OSA-related complications had STOP-BANG and NoSAS scores suggesting high risk for OSA (Table 3). The findings of the assessment of the patients according to STOP-BANG scores are demonstrated in Table 4. When patients were classified as having mild, moderate, and severe risk according to STOP-BANG scores, there was no statistically significant difference between the groups in terms of having OSA-related complications (p=0.358).

Table 3: Results of the STOP-Bang and Berlin questionnaires and NoSAS scores in the group with OSA-related complications

Questionnaire	Low risk		High risk	
	n	%	n	%
STOP-Bang Q.	6	22.20	21	77.80
NoSAS score	6	22.20	21	77.80
Berlin Q.	16	59.20	11	40.80

OSA: Obstructive sleep apnea.

DISCUSSION

In this study, we aimed to investigate whether or not sleep apnea screening questionnaires including STOP-BANG, Berlin, and NoSAS would also predict OSA-related complications following thoracic surgery for lung cancer. Our results demonstrated that neither the STOP-BANG nor Berlin questionnaires nor NoSAS scores predicted OSA-related complications following thoracic surgery for lung cancer. However, 77.60% of the patients who had OSA-related complications were at high-risk for OSA according to STOP-BANG questionnaire and NoSAS score.

To the best of our knowledge, this is the first study that evaluates the use of sleep apnea screening questionnaires for the determination of OSA-related complications following thoracic surgery for lung cancer. Numerous studies were performed to detect the pre-operative OSA risk using questionnaires in some surgical interventions.

Table 4: Comparison of the groups with low and high OSA risk according to the STOP-Bang questionnaire

	STOP-Bang score≤2		STOP-Bang score≥3		p
	n	%	n	%	
Number	13	18.30	58	81.70	
Age, year	57.0±12.4		63.0±7.2		**0.021**
Gender					
Male	9	69.20	51	87.90	0.092
BMI, kg/m^2	24.28±2.71		27.17±4.70		**0.037**
Neck circumference, cm	36.86±3.35		40.14±3.61		**0.004**
Adeno C	5	38.5	14	24.1	0.292
Squomous Cell Ca	8	61.5	42	72.4	0.437
Difficult entubation	1	7.7	7	12.1	0.652
Hypercania	4	30.8	16	27.6	0.818
Hypoxemia	0	0	2	3.4	0.497
NIMW	1	7.7	5	8.6	0.913
IMV	0	0	2	3.4	0.497
Any complication	8	61.5	40	69	0.605
OSA-R comp	6	22.2	21	77.8	0.504
ICU length of stay, hours	18.69±3.98		20.05±1.17		0.187
Time of discharge, days	7.69±3.52		6.97±2.62		0.401

Data is depicted as mean±SD or number, percentage. OSA: Obstructive sleep apnea, BMI: Body mass index, NIMW: Non-invasive mechanical ventilation, IMW: Invasive mechanical ventilation, OSA-R comp: Obstructive sleep apnea-related complications, ICU: Intensive care unit.

Recently, a meta-analysis revealed that STOP-BANG questionnaire might be used as a perioperative risk stratification tool. Among patients undergoing non-cardiac surgical procedures, high-risk OSA (STOP-BANG ≥3) found to be associated with an increased risk of post-operative complications and extended length of hospital stay compared with low-risk OSA (STOP-BANG 0-2).[17] In a retrospective cohort study, 5432 patients who underwent general, ear, nose, and throat, oral maxillofacial, and orthopedic surgery were evaluated the use of the STOP-BANG questionnaire for perioperative patient risk stratification. The authors revealed that STOP-BANG questionnaire was helpful for identifying patients who were at risk of early post-operative and unexpected intraoperative complications.[18] Furthermore, Diken et al.[19] used the STOP-BANG questionnaire to determine the pre-operative OSA risk and relationship with post-operative complications in patients who were scheduled to undergo coronary artery bypass (CABG) surgery. They revealed a significant relation between OSA-related complication and high-risk for OSA.

In our study, 81.70% of the patients had a STOP-BANG score of ≥3. In other words, 81.70% of the patients were at high-risk for OSA according to the STOP-BANG questionnaire. However, we found no relationship between STOP-BANG scores and perioperative complications. The reason for this could be the low specificity and high false-positive rate of the STOP-BANG questionnaire in our population. As recommended previously by Chung et al.,[20] we decided to further classify patients with STOP-BANG scores of at least 3 for moderate-to-severe OSA if the serum HCO3 level was at least 28 mmol/L. Unfortunately, the HCO3 level was above 28 in only four of 71 patients. This condition did not allow us to make further analysis.

Chung et al.[21] used the Berlin questionnaire to identify sleep apnea risk in elective surgical patients. They found that patients at high risk for OSA according to the results had no greater risk for complications than those considered as low risk. Another two studies were conducted in patients undergoing CABG surgery.[22,23] Gokay et al.[24] compared the efficacy of the screening tools and determined that the STOP-BANG questionnaire might be most useful to administer as the initial evaluation for predicting perioperative respiratory complications. In our study, the Berlin questionnaire performed worse than the STOP-BANG questionnaire. Only 40.7% of patients with OSA-related complications had a Berlin questionnaire score ≥2.

To the best of our knowledge, no studies have investigated whether or not the NoSAS score could be used to determine the risk for OSA before surgery. In our study, NoSAS provided similar results to the STOP-BANG questionnaire in patients who underwent thoracic surgery for lung cancer. About 74.60% of the patients had a NoSAS score of ≥8, and 77.80% of patients who had OSA-related complications were described as high risk for OSA according to the NoSAS score. Although patients with STOP-BANG and NoSAS scores suggesting high risk for OSA tended to have more complications; in general, there was no statistically significant difference between patients with high- and low-risk OSA scores in terms of having complications. Pre-operative assessment tools that could predict complications would be very useful. Of the three screening tools evaluated in this

study, the STOP-BANG questionnaire has been investigated across the greatest number of patients. When NoSAS and STOP-BANG scores were compared, the NoSAS score tended to classify fewer patients as being at high risk than STOP-BANG scores in patients without OSA-related complications, although without reaching statistical significance (Table 2). We found more OSA-related complications in women, patients with adenocarcinoma, and patients who needed additional surgical procedures. The development of more complications in women was an interesting finding, although there was no significant difference between men and women in terms of age, BMI, accompanying diseases, and type of surgery performed. However, the number of women in our study was small making it difficult to comment more definitively on this issue.

There are limitations to the present study. OSA diagnosis was not confirmed with polysomnographic examination for patients at high risk for OSA. Because polysomnographic examination was not part of the study protocol. The number of the patients at low risk for OSA according to the questionnaires was small and this may have led to the insufficiency to define a statistically significant correlation. In addition, according to our ICU protocol, it was not appropriate for patients who underwent major thoracic surgery to be separated from nasal oxygen support during their stay in the ICU in the post-operative period. Therefore, this aspect should be taken into consideration when evaluating our hypoxemia data.

In conclusion, neither the STOP-BANG nor Berlin questionnaires nor NoSAS scores predicted OSA-related complications following thoracic surgery for lung cancer. However, 77.60% of the patients who had OSA-related complications were at high-risk for OSA according to STOP-BANG questionnaire and NoSAS score. In view of the high prevalence of sleep apnea in patients with lung cancer, screening for OSA in this population is a useful, high yield pursuit. The NoSAS score may be an appealing candidate due to its simplicity and use of objective parameters.

Disclosures

Ethics Committee Approval: The study was approved by The University of Healthy Sciences, Dr. Suat Seren Chest Diseases and Chest Surgery Training and Research Hospital Ethics Committee (date: 30.06.2016, number: 1389).

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