

**The Correlation between Pre-Operative Obstructive Sleep Apnea Screening and the
Patient Risk for Post-Operative Respiratory Compromise**

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Post-Operative Obstructive Sleep Apnea Patients: The Correlation between Pre-Operative OSA Screening and the Risk for Post-Operative Respiratory Compromise

Obstructive Sleep Apnea (OSA) is a sleep disorder causing a narrowing and collapse of the upper airway, leading to apnea, impaired breathing, hypoxia, and adrenergic stimulation (Broadhead et al., 2022). As obesity rates continue to rise, specifically in the United States, the occurrence of OSA also continues to rise having been identified as the most common risk factor of OSA (Subramani, 2017). The risk is attributed to increased overall weight, as well as increased neck and waist circumference. Individuals with a high BMI, a large neck size, and those who snore are at a higher risk for developing OSA.

Other risk identified risk factors are Type 2 Diabetes, chronic opioid use, certain airway anatomy, and male sex (Wolfe et al., 2016; Yu & Rosen, 2020). It has been estimated that 1 in 4 adult men and 1 in 10 women have OSA (Wolfe et al., 2016). Finkle et al. reported that 90% of adults with OSA were undiagnosed in 2009, and Wolfe et al. estimated that those not diagnosed remained as high as 80% in 2016 and 75-80 percent in 2023 (Huo, et.al.). Despite an increase in awareness that has led to a subtle decline in undiagnosed OSA patients, OSA is still rising and mostly undiagnosed.

The prevalence of underdiagnosis could have consequences when individuals with OSA undergo surgery, specifically causing an increased risk for respiratory complications and mortality (Mills, 2018). Patients may experience respiratory decompensation, decreased oxygen saturation, and airway obstruction. These complications can then lead to post-operative compromise and, without prior diagnosis of OSA, certain safety precautions may not be implemented, jeopardizing the patient's safety. Furthermore, if nurses are unaware of a patient's increased risk of respiratory compromise, the patient may not be as closely monitored. Actions

such as sitting the patient up, lying the patient on his/ her side, utilizing a CPAP machine, and decreasing or avoiding opioid use may not be implemented.

Öner et al. (2023) aimed to highlight common topics of interest in anesthesia regarding opioids and CPAP machines and their effect on respiratory compromise post-operatively. Öner et al. found there continues to be an increase in OSA complications with a focus on airway management and post-operative pain control.

The Need for Identification

Hillman et al. (2024) conducted a systematic review examining the importance of identifying patients with OSA prior to surgery. Hillman et al. found that safe perioperative management of patients with OSA heavily depended on identification of risks and thorough preparation for potential airway obstruction. They highlighted that, despite the problem of OSA underdiagnosis in 2004 and the apparent need for more research to be done, OSA is still being underdiagnosed and under identified prior to surgery today.

Broadhead et al. (2022) discussed the continuing underdiagnosis of OSA and supported the continuing need for identification of OSA patients prior to surgery. They emphasized that identifying OSA in the pre-operative phase can aid providers in avoiding respiratory and airway compromise that can occur if airway interventions are not implemented. Early diagnosis can also assist with recognition of early pathological signs that may lead to an increased length of stay. Broadhead et al. focused on OSA interventions based on hospital guidelines on 413 patients with a pre- and post-intervention evaluation of respiratory status to determine intervention effectiveness. There were no statistically significant findings, as pre-and post-test results after OSA identification and management education showed minimal outcome change. However, they

claim that increased recognition of OSA by PACU staff could still lead to improved care due to increased awareness of both the disease process and potential complications.

Chambers et al. (2023) supported Faria et al.'s (2021) findings that up to 80% of individuals are still undiagnosed. Chambers et al. claimed these individuals are at a great risk for perioperative issues, and that proper pre-evaluation of OSA severity is necessary for risk mitigation.

Post-Operative Pulmonary Complications

The risks for various pulmonary complications exist for any patient in the perioperative setting, specifically post-operatively. These complications, however, are of more concern with individuals with chronic respiratory diseases, such as OSA.

Mills (2018) discussed postoperative pulmonary complications and the intraoperative and postoperative care of surgical patients, such as interventions like low tidal volumes and PEEP. Mills highlighted that post-operative pulmonary complications (PPCs) are a major determinant of patient outcomes and can have an impact on patient well-being; with a rise in PPCs comes worsening patient outcomes and longer hospital stays. Additionally, chronic respiratory diseases, such as OSA, are considered independent mortality risks which increase morbidity and mortality post-operatively. Mills concluded that there is a need for better prediction of complications to increase prevention, and that future research should focus on prevention to minimize the consequences of post-operative pulmonary complications.

Subramani et al. (2017) conducted a systematic review examining the different races, ages, and causes of OSA. The authors aimed to describe the clinically relevant endotypes and phenotypes of OSA. Subramani et al. reported a higher risk of respiratory arrest in the perioperative setting for patients with OSA, especially who had a high arousal threshold and

sensitivity to sedatives and narcotics. It was also reported that the pathophysiology of OSA varies between individuals. The authors concluded that further research should be conducted on potential treatment options that can help decrease the disease burden of OSA and improve treatment effectiveness.

Pre-Operative OSA Screening Tools

Wolfe et al. (2016) reported that surgery places OSA patients at a high risk for apneic episodes and other complications, and that preoperative screening tools can help identify these patients. Verbraecken et al. (2017) explained that the goal for screening is to “rule in and rule out patients with the highest possible sensitivity and specificity, evaluated against costs” (p. 2). The authors emphasized that screening tools must be concise yet structured. Verbraecken et al. concluded that pre-screening in general should be a necessary step to avoid perioperative complications.

OSA screening tools are those which evaluate various risk factors for OSA to identify patients with the disease before heading into surgery where airway compromise is problematic. Four tools that have been validated for OSA screening are the STOP questionnaire, the STOP-Bang questionnaire, the American Society of Anesthesia (ASA) Checklist, and the Berlin questionnaire. Three other tools have been utilized and include the Epworth-Sleepiness Scale, BASH-GN, and the Mallampati Scale.

STOP or STOP-Bang Questionnaires

The STOP questionnaire has four screening questions measuring the presence of loud snoring, feelings of tiredness/ fatigue/ daytime sleepiness, observed periods of stopped breathing/ gasping/ choking, and a history of high blood pressure. An individual considered low risk when given a score of 0-2, intermediate risk with a score of 3-4, and high risk with a score of 5-8.

The STOP-Bang questionnaire has eight screening items. Included are four STOP questions (mentioned above) and four additional screening categories as follows: a BMI greater than 35; age greater than 50; a large neck size (17” or greater for males or 16” or greater for females); and a biologic male sex. An individual is positive for OSA if answering yes to 3 or more questions.

Wolfe et al. (2016) recommended these two tools should be included in every pre-op examination, as they would provide a diagnosis for 93% of a patient population with no prior diagnosis of OSA. Öner et al. (2023) recognized the strengths of these tools; however, other comorbidities and indicators, such as Type 2 Diabetes; chronic opioid use; and an airway assessment included in the Mallampati Scale would improve the tools’ diagnosing abilities.

ASA Checklist

The ASA Checklist includes the same items as the STOP-BANG questionnaire, evaluated using 14 items. The additional screening items include naso, pharyngeal, and laryngeal obstruction; craniofacial abnormalities, daytime sleepiness, and remaining tired upon waking. These are broken into the categories of predisposing physical characteristics, history of airway obstruction, and somnolence. Thus, effectiveness and means of improvement are similar, and the patient is at a high risk for OSA if two or more categories are positive. Munish et al. (2012) explained that the ASA Checklist is a highly sensitive tool with a “95.1% sensitivity and 52.2% specificity” (p. 223), allowing it to identify patients at high risk for OSA.

Berlin Questionnaire

The Berlin Questionnaire includes 10 items divided into three categories, and positive scores in two or more categories indicate a high risk for OSA. The screening questions surround snoring, daytime sleepiness, hypertension, and a high BMI. Khan et al. (2013) indicated that this

tool is best used in the primary care setting rather than in a general surgical population, especially bariatric surgery patients, since obesity is a large predictor of OSA in the scoring for this questionnaire and bariatric patients may be mistakenly identified with having OSA due to higher BMIs. Improvements by Khan et al. included the development of an alternative scoring scheme for the bariatric population, with the inclusion of characteristics such as sex, age, and neck circumference.

Epworth-Sleepiness Scale

The Epworth-Sleepiness Scale is a general, non-OSA specific tool that assesses an individual's likelihood of "nodding off" or falling asleep when engaging in specific activities or situations. These include sitting and reading, watching TV, being a car passenger, as well as sitting and talking. The patient rates these situations on a scale of 0-3 in which 0 indicates "would never nod off" and 3 indicates "high chance of nodding off." A cumulative score of 10 or greater indicates a need for further assessment. Rosenthal and Dolan (2008) indicate that this tool is better used for assessing daytime sleepiness, as it can be caused by many sleep disorders, but can be used in conjunction with an OSA-specific screening tool since daytime sleepiness is a risk factor for OSA.

BASH-GN

The BASH-GN is a machine learning, 6-item questionnaire that is used to predict the risk of moderate to severe OSA by considering OSA subtypes. Assessment for risk factors including age, sex, neck circumference, BMI, hypertension treatment, and snoring is completed by a healthcare provider. Patients are separated into two groups, a low or high phenotype group, depending on symptoms. Huo et al. (2023) emphasized that current OSA screening tools (including those mentioned above) lack the consideration of subtypes and rather use a

standardized approach, which can cause inaccuracy. Huo et al. also highlighted that BASH-GN is an easier way to gather and assess data compared to other tools, but that it cannot assess for other disordered breathing conditions other than OSA.

Mallampati Scale

The Mallampati Scale assesses oropharyngeal anatomy to determine risk for OSA by having patients open their mouths and extend their tongues. Four grades exist and depend on the ability to visualize tonsillar pillars, the soft palate, the uvula, and the hard palate. The higher the grade, the higher the risk for OSA and a difficult intubation. Yu and Rosen (2020) indicated that every 1-point increase in the Mallampati Scale was associated with a 2.5 odds ratio of having OSA. While Yu and Rosen stated that many consider the Mallampati Scale a useful tool in determining OSA risk, they also mentioned that others argue that it is a subjective assessment with little predictive value.

Overall, these screening tools consider many variables that contribute to OSA (snoring, BMI, neck size, and sex); however, the previously discussed tools do not examine other risk factors including Diabetes Type 2 or chronic opioid use. Although many improvements can be made, all the above tools are available resources when pre-operatively evaluating OSA risk, as identification is important for minimizing PPCs.

Management Guidelines

Proper management of perioperative patients with OSA is crucial in improving patient outcomes. de Raaff et al. (2017) highlighted several methods of OSA management including polysomnography for diagnosing OSA, the recommendation of CPAP for patients with moderate-severe OSA, continuous pulse oximetry monitoring, and the minimized use of sedatives and opioids in the perioperative phase. de Raaff et al. (2018) conducted a study which

reported that intraoperative precautions such as preoxygenation, a ramped position, and CPAP also aid in the decrease of complications. Other interventions identified included positive end-expiratory pressure (PEEP) during induction, low tidal volume maintenance, an avoidance of opioids, and continuous pulse oximetry monitoring.

Cozowicz and Memtsoudis (2021) reviewed ASA postoperative management recommendations for OSA. Specifically, the use of regional or local anesthetics to reduce opioid effects and requirements, necessary monitoring with the concurrent use of sedative agents due to an increased risk for respiratory depression and airway obstruction, and continuous supplemental oxygen administration until baseline oxygen saturation is reached. Other recommendations involved continuous pulse oximetry, nonsupine positions, and the continuous administration of CPAP or other non-invasive positive-pressure ventilation.

Oh et al. (2022) discussed several airway management interventions which included the ramped positioning of patients to improve the laryngoscopic view during intubation and maximal preoxygenation. Oh et al. stated that an opioid-sparing analgesic approach should be followed to reduce post-operative respiratory complications; medications such as NSAIDs, lidocaine, and dexamethasone can also be administered. Post-operative non-invasive positive-pressure ventilation, such as a CPAP, should also be employed to improve gas exchange and prevent airway collapse.

These recommended practices can reduce postop complications in many ways. They should be followed to improve patient safety and outcomes, perhaps in a standardized protocol.

Summary

There is a need to identify OSA in surgical patients preoperatively. Without proper diagnosis, there is an increased risk of airway collapse and decreased gas exchange potentially

leading various serious and harmful respiratory complications. The purpose of this study is to determine the use of pre-operative OSA screening tools and if there is a correlation between screening and post-operative respiratory complications. The research questions are:

1. Were patients screened for OSA preoperatively? If so, what tool was used?
2. Of those screened, how many were identified as low, medium, or high risk?
3. How many patients experienced postop complications?
4. Of those with complications, how many were screened?

It is hypothesized that use of OSA screening tools will be related to a decreased risk of complications in the post-operative period.

Methods

Design

An Institutional Review Board (IRB) approved this study. A non-experimental, cross-sectional retrospective descriptive design was used to answer the research questions. The aim was to determine if there is a correlation between pre-operative OSA screening and respiratory complications post-operatively.

Sampling

The population was surgical patients aged 30-69. The incidence of OSA in this age group is thought to be about 1 billion (Chambers et al., 2023). The accessible population was individuals who underwent bariatric surgery or orthopedic surgery at a regional medical center during the last six months of 2024. Thus, a comparison in OSA evaluation may be made among a high-risk group (bariatric surgical patients) and a more generalized group (orthopedic surgical patients). Inclusion criteria was males, aged 30-69, undergoing bariatric or orthopedic surgery. Only males were selected, as it was estimated that 1 in 4 adult men have OSA (Wolfe et al.,

2016). Exclusion criteria were women and those not meeting the inclusion criteria. Informed consent was not necessary as chart review was used for data collection and patients complete a form allowing their private health chart information (PHI) be used for research.

Data Collection Plan

The inclusion and exclusion criteria, along with desired data points such as BMI, tobacco use history, substance use history, airway class were provided to the medical center's nurse researcher who was able to create a data report sheet from a chart audit. 120 patient charts were selected (N= 120). Data collected included age, race, BMI, comorbid conditions (diabetes, tobacco use, substance use), type of surgery (bariatric or orthopedic, OSA screening (if it was done, what tool, what score), post-op respiratory complications and type, and interventions (CPAP/ BiPAP use, lateral positioning, decreased opioid administration). SPSS software will be used to analyze the data to answer the research questions.

The report sheet excluded identifiable data; however, not all data necessary for this research was able to be pulled in the initial report (OSA screening tools and scores, interventions such as decreased opioid administration and CPAP use.). Consequently, Facility Identification Number (FINs) were provided, numbers the hospital assigns to patients, and the student nurse was required to sit in the computer lab at the medical center and perform a manual chart audit to gather data for the rest of the necessary data points.

Measures

This study utilized a quantitative chart review. A chart audit sheet was developed in excel to record information. Charts were reviewed to determine if OSA had been assessed preoperative and if so, what measure(s) were used. If assessed, the scores were recorded and the post-operative period was reviewed to determine the incidence of any respiratory complications post-

op. Additionally, it was determined whether certain post-op interventions were implemented or not.

Analysis

Sample Characteristics

The males ranged in age from 30-68 with a mean age of 51.5 (sd =10.7). There was no significant difference in the mean age of those undergoing orthopedic (x=52, sd =10) and bariatric surgery (x=51, sd= 10). All but seven were White (n=113, 94%), six were Black (5%), and one was Asian (1%).

Risk Factors for OSA

BMI. The range of BMI was 15.1-54.2. A t-test comparing BMI's between bariatric and orthopedic surgery patients. Bariatric patients had significantly higher BMIs (x=34.5, sd= 6.8) compared to orthopedic patients (x=30.8, sd =7.4) (t=2.5, df= 118, p=.006) which was to be expected for that population.

Diabetes. A total of 34 males (66.7%) did not have a history of Diabetes (type 1 or 2), while 17 males (33.3%) were Diabetic. The rest did not have this data charted. Of those with Diabetes, 16 (94%) experienced respiratory complications. Of those without a diagnosis of diabetes, 22 (65%) experienced post-op respiratory complications.

Tobacco Use. A total of 55 patients (78.6%) reported current or past tobacco use and experienced respiratory complications. Most patients denied a history a substance use (77.4%) with 14.8% reporting current use and 7.8% reporting past use.

Post-Op Variables & Interventions

Preop Assessment. A total of 70 patients (58.3%) went through Pre-Anesthesia Testing (PAT), a pathway at the partner medical center in which patients deemed higher risk due to

existing conditions or comorbidities are assessed in advance before their procedure. There were 37 patients identified with a history of OSA. A Chi-Square Test was completed to assess the significance between those with a previous history of OSA and those who went through PAT. The findings were significant showing that the majority of patients with a history of OSA went through PAT ($\chi^2=14.3$, $df=1$, $p<.001$). Another Chi-Square test was performed to assess the significance between those with a previous OSA diagnosis and screening. The findings were significant showing that majority of patients who had a previous OSA diagnosis were screened pre-operatively ($\chi^2=16.1$, $df=2$, $p<.001$).

When assessing post-op interventions, the majority of males ($n=95$, 79.2%) did not use a CPAP post-op while 25 (20.8%) did. Most of the patients ($n=115$, 95.8%) were not placed in a lateral position. Additionally, the majority also did not have opioid administration reduced post-operatively ($n=101$, 84.2%)

Research Question #1: Were patients screened for OSA preoperatively? If so, what tool was used?

Sixty-eight patients (56.7%) undergoing either surgery type were screened for OSA pre-operatively, while 51(42.5%) were not. All but one of the patients screened went through PAT, and all patients were assessed with the STOP-Bang tool. All but 4 (11%) of the 35 bariatric patients were screened, while the majority of the orthopedic patients were not screened ($n=85$, 55%).

Research Question #2: Of those screened, how many were identified as low, medium, and high risk for OSA?

Of the 68 patients screened for OSA, 42 (62%) were identified as having a risk, and 26 (38%) did not have a risk for OSA. Of those screened and having a risk, 14 (33.3%) had a low risk, 19 (45.2%) had an intermediate risk, and 9 (21.4%) had a high risk of OSA.

Research Question #3: How many patients experienced post-op complications?

A total of 87 (72.5%) patients experienced respiratory complications post-operatively. The most common complication was bradypnea (n=58, 66.7%) followed by tachypnea (n=24, 27.6%) and low oxygen saturation (n=5, 5.7%).

Research Question #4: Of those with complications, how many were screened?

Of the 58 patients who experienced bradypnea, 32 (55%) were screened for OSA. Of the 24 who experienced tachypnea, 15 (62.5%) were screened for OSA. Finally, of the 5 who experienced a low oxygen saturation, 3 (60%) were screened for OSA.

Relationship Between Screening and Respiratory Complications

A Chi-Square test of association was conducted to examine the relationship between pre-operative OSA screening and post-operative respiratory complications. Of the patients who were screened pre-operatively for OSA, 57.5% experienced respiratory compromise post-operatively while 57.6% did not. Among patients who experienced respiratory complications, there was no difference in screening, as 72.5% had pre-op OSA screening and 72.5% did not have pre-op screening. The Pearson Chi-Square test revealed no statistically significant association between screening and respiratory complications, $\chi^2(1) = .000$, $p = .992$. These findings suggest that there is no significant difference in post-op respiratory complications between individuals with and without pre-op OSA screening.

Discussion

This retrospective 6-month analysis of pre-operative OSA screening and post-operative respiratory complications showed no correlation between the two variables, as nearly the exact same percentage of patients experienced respiratory complications regardless of screening (~58%). Additionally, for those who experienced respiratory compromise there was no difference in screening administration (both 72.5%). This contradicts expected findings and popular beliefs in literature that screening would lead to less respiratory complications (Broadhead et al., 2022) and that proper pre-evaluation of OSA was vital for risk mitigation (Chambers et al., 2023).

This shows that pre-operative OSA screening does not correlate to a change in the respiratory outcome of patients post-operatively. This conclusion is believed to have stemmed from the lack of standardization within the hospital partnered with regarding screening; each anesthesia provider has a different protocol with their patients always screened while others are never or rarely screened.

When conducting chart reviews, there was a lack of charting standardization, as information was not charted the same for all patients with some missing information or having it in a different location. Additionally, all patients who went through PAT were screened, while those that did not were not. It is also interesting to note that most patients who had a previous OSA diagnosis were sent through PAT. There is also believed to have been improper standardization of what classified as a respiratory compromise when recording data, as no specific parameters were in place regarding when to include and exclude a respiratory symptom. The points above could have impacted the ability to gather adequate data for the entire sample and may have skewed the outcome. Moreover, the respiratory complications may not all be due

to OSA; some may be due to opioid administration post-op, an increase in pain during the post-op period, or a lack of post-op interventions being employed.

It was also found that more bariatric patients were screened compared to orthopedic patients, which followed expectations that the higher risk group would be screened for OSA more. However, there were only 35 bariatric surgery patients in the sample which may have altered the outcome because of the lower sample size for this group. Moreover, for patients reporting on tobacco, substance use, or elements of the OSA screening tools, it is important to note that not all patients may have reported truthfully.

It is recommended that hospitals standardize their screening processes and protocols, as well as charting, to provide consistent data. However, it is a positive to note that higher risk patients (bariatric surgery patients and those with a pre-existing OSA diagnosis) were screened, showing that the partner hospital may already be considering precautions for these populations.

For future research, it is recommended that strict outlines be put in place for categorizing respiratory complications and recording them during data collection. Additionally, an equal number of bariatric and orthopedic surgery patients should be included in the sample, if possible, to allow for more accurate comparisons. Additional research could also address the underdiagnosis of OSA.

Conclusion

Screening for OSA in the perioperative setting is important due to implications on the respiratory system. This study found a relationship between pre-operative OSA screening and post-operative respiratory compromise; findings indicate that screening did not correlate to a change in the rate of respiratory complications post-operatively. It is interesting to note that bariatric surgery patients were screened more often than orthopedic surgery patients, but

limitations (as outlined above) apply. It is concluded that this study be replicated with the recommendations provided to further assess the relationship between screening and respiratory complications or to address the underdiagnosis of OSA.

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