Implementation of an Obstructive Sleep Apnea Screening Program at an Overseas Military Hospital

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Anesthesia providers and surgeons do poorly at consistently identifying patients with obstructive sleep apnea (OSA) without use of screening tools. Aims of this evidence-based-practice project were to determine whether educating nurses about OSA and incorporating the STOP-BANG Questionnaire into preoperative forms was associated with an increased identification of patients with suspected OSA and an increased frequency of nurse-generated anesthesia consultation for OSA. A retrospective chart review of 100 consecutive records over a 1-month period using the STOP-BANG Questionnaire criteria was completed before and after implementation of the education and screening program at US Naval Hospital Okinawa, Japan. A STOP-BANG Questionnaire score of 3 or higher indicated high risk of OSA. Descriptive and inferential statistics were used to analyze results. Two hundred charts were reviewed. The prevalence of a STOP-BANG score of 3 or more increased from 5% to 21% after program implementation (P = .001). The frequency of anesthesia consultation for known or suspected OSA by our nursing staff increased from 5% to 26% after implementation (P = .0001). After this educational intervention with preoperative nurses and redesign of preoperative forms to incorporate the STOP-BANG Questionnaire, an increased proportion of patients at high risk of OSA were identified.

Keywords: Anesthesia, obstructive sleep apnea, screening, STOP-BANG Questionnaire.
Obstructive sleep apnea, especially when moderate to severe, is associated with increased perioperative complications. The incidence of undiagnosed OSA in surgical and gastroenterologic patients ranges from 21% to 40%. During the perioperative period, OSA is associated with adverse respiratory and cardiovascular outcomes. Therefore, it is critical to identify and treat patients with OSA. Polysomnography (sleep study) is the gold standard for diagnosis of OSA; however, sleep studies are expensive and difficult to obtain preoperatively because of limited resources and scheduling issues. Fortunately, without validated screening questionnaires, anesthesia providers and surgeons do a poor job of identifying surgical patients with undiagnosed OSA. In one study, 60% of anesthetists and 92% of surgeons failed to identify patients with preexisting or undiagnosed moderate to severe OSA. Screening based simply on gender or obesity tends to miss the presence of OSA. In the perioperative period, patients with OSA present challenges that must be addressed to minimize the risk of perioperative morbidity or mortality.

There are many screening tools available to evaluate patients who are at risk of OSA. They include the Berlin Questionnaire, the American Society of Anesthesiologists (ASA) Checklist, and the STOP-BANG Questionnaire. These screening tools have been validated in the surgical population and have various levels of sensitivity and specificity. The STOP-BANG Questionnaire has proved useful for preoperative identification of patients at high risk of OSA and will be explored as an alternative to polysomnography as a screening tool for patients at high risk of OSA at Naval Hospital Okinawa.

Naval Hospital Okinawa has no specific screening tool used by staff to identify patients at high risk of OSA preoperatively. In the past decade the STOP-BANG Questionnaire was validated as a screening tool for OSA in the preoperative setting for surgical patients. At Naval Hospital Okinawa the anesthesiology preoperative evaluation form asks questions on some of the clinical signs and symptoms of OSA, but does not present these questions in an organized fashion. We believe that educating our ambulatory procedure nurses on the pathophysiology and risk factors for OSA (STOP-BANG questions) will improve our ability to identify patients at risk of OSA during the preoperative assessment.

Review of the Literature
• Prevalence of Obstructive Sleep Apnea. Finkel et al. in a study of 2,778 consecutive surgical patients, estimated that the prevalence of OSA among adult surgical patients was 22%. In this study, the authors reported that 82% of the patients observed to be at high risk of OSA had never received a diagnosis of OSA. Chung et al. using a STOP-BANG score of 3 or greater, found that 28% of 2,721 surgical patients were at high risk of OSA. Also using the STOP-BANG Questionnaire, Coté et al. determined that 43% of patients undergoing advanced endoscopy procedures were at high risk of undiagnosed OSA. Boese et al. using the Berlin Questionnaire, found a 40% incidence of undiagnosed OSA in patients undergoing colonoscopy with sedation administered by a registered nurse. What is most alarming from these studies is that a large number of patients have undiagnosed OSA, and thus they may be at higher risk of perioperative complications.

• Screening Tools for Obstructive Sleep Apnea. The ASA Task Force on Perioperative Management of patients with obstructive sleep apnea agree that in the absence of a sleep study, a presumptive diagnosis of OSA may be made with consideration of the following criteria: increased BMI, obesity, increased neck circumference, snoring, congenital airway abnormalities, daytime hypersomnolence, inability to visualize the soft palate, tonsillar hypertrophy, and observed apnea during sleep. These criteria are often used as the basis for screening tools to evaluate patients who are suspected of having OSA. The ASA Task Force further agrees that pre-procedure identification of patients with OSA improves perioperative outcomes. The Society for Ambulatory Anesthesia and the American Society of PeriAnesthesia Nurses both have published guidelines recommending preoperative screening for patients with known or suspected OSA.

The screening tools used to identify patients at high risk of OSA include the Berlin Questionnaire, the ASA Checklist, and the STOP-BANG Questionnaire. The Berlin Questionnaire was developed in 1996 and is composed of questions about risk factors for sleep apnea, including snoring, wake time sleepiness or fatigue, obesity, or hypertension. The questionnaire consists of 11 questions grouped into 3 categories related to the risk of having OSA. It has a moderately high level of sensitivity in surgical patients (68.9%) and a higher sensitivity for surgical patients with moderate to severe OSA (78.6%-87.2%). The specificity for mild OSA is 56.4%; moderate, 50.5%; and severe, 46.4%. This tool was initially developed for use in the primary care setting, but has since been validated in the preoperative setting. In one study, the Berlin Questionnaire identified 24% of all surgical patients as being at high risk of OSA.

The ASA Checklist is a 3-category checklist with 12 items for adults, and it also may be adapted for children. It evaluates predisposing characteristics, obstructive symptoms during sleep, and daytime somnolence. Compared with the Berlin Questionnaire, this checklist
questionnaire demonstrates a similar level of sensitivity but slightly lower specificity. The sensitivity for mild OSA (AHI > 5) is 72.1% and specificity is 38.2%, for moderate OSA (AHI > 15) the sensitivity is 78.6% and the specificity is 37.4%, and for severe OSA (AHI > 30) the sensitivity is 87.2% and the specificity 36.2%.22

The STOP-BANG Questionnaire has been validated in multiple surgical populations and is the most widely used. The questionnaire contains 4 questions and 4 clinical characteristics of OSA (snoring, tiredness, observed apnea, high blood Pressure, BMI > 35 kg/m2, Age > 50 years, neck circumference > 40 cm, and male gender). The questionnaire is a self-report, forced-choice (yes/no) questionnaire that can be completed in less than 1 minute. A score of 3 or higher is considered high risk of OSA. The STOP-BANG Questionnaire was based on the Berlin Questionnaire, consensus of a group of anesthesiologists, sleep specialists, and literature review. The questionnaire is convenient to use in the surgical population. The sensitivities noted for this tool at AHI cutoffs greater than 5 (mild OSA), greater than 15 (moderate OSA), and greater than 30 (severe OSA) are 83.6%, 92.9%, and 100% and the negative predictive values are 60.8%, 90.2%, and 100%, respectively. The specificity for mild, moderate, and severe OSA are 56.4%, 43%, and 37%, respectively. Patients with a STOP-BANG Questionnaire score of 5 or greater were 10 times more likely to have severe OSA.23 These results suggest that a score of 5 or more may be a better cut-score for identifying patients with moderate to severe OSA. With the STOP-BANG Questionnaire, if a patient is classified as being at low risk (score < 3), there is a low probability the patient has moderate to severe OSA. In contrast, if a patient has a high score (≥ 5), there is a high likelihood that person have moderate to severe OSA.

• STOP-BANG and Perioperative Outcomes. Several studies have examined the utility of the STOP-BANG Questionnaire in the surgical and endoscopy populations and found it to be predictive of adverse outcomes. Coté et al13 examined the utility of the STOP-BANG Questionnaire in patients presenting for advanced endoscopic procedures. In this study, the authors reported that patients with a STOP-BANG Questionnaire score of 3 or greater were significantly more likely to require airway maneuvers and were more likely to experience sedation-related complications. Vasu et al7 in a historical cohort study, analyzed the clinical utility of the STOP-BANG Questionnaire in predicting these perioperative complications in 135 surgical patients: presence or absence of new-onset atrial fibrillation, systemic hypotension (systolic blood pressure < 90 mm Hg that required aggressive therapy), myocardial infarction, or pulmonary complications (hypoxemia, atelectasis, pulmonary embolism, or pneumonia). They found that patients who had a score of 3 or greater were 11.4 times more likely to experience a postoperative complication. They found the STOP-BANG Questionnaire had high sensitivity (91.7%), moderate specificity (63.4%) to predict postoperative pulmonary complications. Vasu et al7 concluded that the STOP-BANG Questionnaire may be helpful in identifying surgical patients at high risk of postoperative cardiopulmonary complications.

In a recent evidence-based project conducted by Lakdawala,29 the STOP-BANG Questionnaire was implemented as a screening tool for undiagnosed OSA in surgical patients. After implementation of a formal screening program, the incidence of suspected OSA increased from 4% to 18%. The author concluded that this screening program improved patient safety and outcomes.

Review of the literature indicates that the STOP-BANG Questionnaire is a reliable, valid, easy-to-use tool for identifying patients at risk of undiagnosed OSA. The purposes of this evidence-based project were to educate our preoperative nurses on the identification, risks, and complications associated with OSA and to incorporate the STOP-BANG Questionnaire into their preoperative screening process. Identification of patients at high risk of OSA will enable anesthesia providers and nurses to develop an anesthetic and postoperative care plan that will improve perioperative care and decrease complications.

Methods
The aims of this evidence-based practice project were to determine whether educating nurses on OSA and incorporation of the STOP-BANG Questionnaire into their preoperative screening process was associated with (1) an increased identification of patients with suspected OSA during the preoperative visit and (2) an increased frequency of nurse-generated anesthesia consultation for OSA.

This evidence-based practice project was conducted at US Naval Hospital Okinawa in Okinawa, Japan, after obtaining institutional review board approval from Naval Medical Center San Diego and the University of Alabama, Tuscaloosa. Naval Hospital Okinawa provides care to more than 55,000 military servicemen and women. Most of the adult patients are young active duty servicemen or women or their family members, with ages ranging from 18 to 70 years. Naval Hospital Okinawa has 4 main operating rooms and 2 obstetric operating rooms. The Anesthesia Department is staffed by 5 anesthesiologists and 7 Certified Registered Nurse Anesthetists. The Ambulatory Procedure Unit is staffed by 8 registered nurses who prepare patients for surgery. Each patient scheduled for elective surgery completes a standard anesthesiology preoperative questionnaire. Before implementation of this project, the preoperative anesthesia questionnaire used at Naval Hospital Okinawa collected information on all the clinical signs and characteristics of OSA listed on the STOP-BANG Questionnaire except for neck circumference. However, the OSA questions were not listed in
an organized fashion, and older versions of the question-naire, which sometimes were used by nursing staff, did not include a question about apnea symptoms. All anesthesia preoperative questionnaires were reviewed by Ambulatory Procedure Unit nursing staff, and based on departmental guidelines, they would consult one of the anesthesia providers on duty to interview the patient before the day of surgery for certain comorbidities (ie, coronary artery disease, morbid obesity). Before implementation of this project, OSA was not one of the criteria that would automatically trigger an anesthesia consultation.

This project consisted of a 1-month retrospective chart review of 100 medical records to determine the baseline prevalence of patients at high risk of OSA using the components of the STOP-BANG Questionnaire (January 2011). As previously mentioned, our anesthesia preoperative questionnaire did not have a place to record neck circumference, and some older versions did not include a question asking about apnea symptoms during sleep. Patients with a current diagnosis of OSA were also included in the overall prevalence. Investigators recorded the frequency of anesthesia consultation for OSA. Next our nurses were educated about OSA and the STOP-BANG Questionnaire. The OSA education training consisted of a digital slide (PowerPoint, Microsoft) presentation on OSA pathology, risk factors for OSA, perioperative complications, identification of STOP-BANG Questionnaire components, and how to complete and score the STOP-BANG Questionnaire. Our nurses were instructed to refer all patients with a diagnosis of OSA and/or a score of 3 or higher on the STOP-BANG Questionnaire for an anesthesia consultation before surgery. Thirty days after the educational training, the STOP-BANG Questionnaire was incorporated into the preoperative screening process. Next a retrospective chart review of the medical records of 100 consecutive adult surgical patients were reviewed, results from the STOP-BANG Questionnaire were recorded, and the prevalence of OSA was calculated (February 2011). We also examined these records to determine the frequency of anesthesia consultation for OSA after implementation of the screening program. The prevalence of high risk of OSA was based on a score of 3 and above on the STOP-BANG Questionnaire or a diagnosis of OSA based on patient self-report. Exclusion criteria consisted of cesarean delivery for women, age younger than 18 years, or emergency surgery. We excluded emergency surgeries because we found in many cases the STOP-BANG Questionnaire was not completed by the anesthesia provider.

Descriptive statistics were used to examine baseline demographics and to analyze the prevalence of patients at high risk of OSA and frequency of anesthesia consultation for known or suspected OSA. A \( \chi^2 \) test was used to test the association between high or low risk of OSA (score > 3 on STOP-BANG) at baseline and after implementation. A \( \chi^2 \) test was also used to test the association between presence or absence of high risk of OSA (score ≥ 3 on the STOP-BANG) and the need for anesthesia consultation (yes or no) at baseline and after implementation of the educational program. A P value below .05 was considered significant. A power analysis was not conducted because the baseline prevalence rate for OSA in patients presenting for surgery at Naval Hospital Okinawa was unknown.

**Results**

A total of 200 charts were reviewed: 100 before and 100 after implementation of the program. STOP-BANG Questionnaire results are presented in the Table. Before implementation only 59 of the charts reviewed had information recorded on apnea symptoms during sleep, and only 44 had the neck circumference recorded. The incidence of a STOP-BANG Questionnaire score of 3 or greater was 5% before education of our nursing staff and incorporation of the STOP-BANG Questionnaire into the preoperative screening process and was 21% after implementation \((P = .001; \text{Figure})\). Before implementation 6 patients reported a diagnosis of OSA, whereas only 1 reported a diagnosis after implementation. The incidence of tiredness, observed apnea, high blood pressure, and age above 50 years all were significantly higher compared with baseline \((P < .05)\). Because of baseline differences in the percentage of patients with age above 50 and a history
of high blood pressure, a post hoc analysis comparison was completed on the STOP-BANG Questionnaire total score that excluded these 2 variables. Mean STOP-BANG Questionnaire scores after implementation excluding age and history of high blood pressure were still significantly higher compared with before implementation of OSA screening with the STOP-BANG Questionnaire by our nursing staff (1.18 ± 1.02 vs 0.91 ± 0.68, \(P = .03\)). Also significantly higher was the proportion of patients with a STOP-BANG score of 3 or more (11% vs 3%, \(P = .049\)).

The frequency of anesthesia consultation for known or suspected OSA by our nursing staff increased from 5% to 26% after implementation (\(P = .0001\)).

**Discussion**

It is imperative before surgery to identify patients with OSA, especially when moderate to severe, so risk reduction strategies can be implemented. Obstructive sleep apnea is frequently undiagnosed in surgical patients, and the initial recognition often occurs during medical evaluation undertaken on the day of surgery. The findings of this evidence-based practice project suggest that educating our nurses on OSA, combined with redesign of preoperative forms to include the STOP-BANG Questionnaire, was associated with an increased number of patients at risk of OSA. The prevalence of OSA in this study after incorporation of the STOP-BANG Questionnaire (21%) into the preoperative evaluation is consistent with the rates reported by Finkel et al. The use of the STOP-BANG Questionnaire was associated with an increased number of patients interviewed by an anesthesia provider for known or suspected OSA. Given that OSA increases the risk of perioperative complications, we believe our project improved patient safety at our institution.

Before implementation of the STOP-BANG Questionnaire at our institution, we found that the clinical characteristics and symptoms of OSA were not evaluated in a systematic manner, and many records did not include information on apnea symptoms during sleep or neck circumference. Our baseline review of 100 medical records found that 41% of charts did not have information on apnea symptoms and 56% did not have information on neck circumference. This omission of data on apnea and neck circumference may have contributed to the low prevalence of OSA and lower mean STOP-BANG Questionnaire score at baseline.

Educating our nurses about the risk factors for OSA and incorporation of the STOP-BANG Questionnaire into the preoperative screening process helped improve their ability to identify at-risk patients, we believe. This was associated with an increased number of anesthesia consultations for OSA before the day of surgery. The importance of early identification of patients at high risk of OSA cannot be understated. Patients who have OSA are at increased risk of perioperative complications.

- **Limitations.** This project has several limitations. First, during implementation it was noted by the authors that the nurses were intermittently using an older version of the Anesthesia Preoperative Form, which may have resulted in the low prevalence of OSA. Additionally, apnea symptoms and neck circumference information was not consistently recorded on the charts. Another limitation of this project is that no data were collected on type of surgery; review of the literature suggests certain surgical populations have a higher incidence of OSA. However, Naval Hospital Okinawa does not perform bar-

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### Table. Frequency of Clinical Characteristics and Symptoms of Obstructive Sleep Apnea (OSA) Before and After Implementation of Education and Screening Program With STOP-BANG Questionnaire

- Only 59 had information on apnea symptoms and 44 patients had information on neck circumference out of 100 charts reviewed at baseline.
- A patient was at high risk of OSA if STOP-BANG questionnaire score was 3 or higher.

<table>
<thead>
<tr>
<th>STOP-BANG characteristic</th>
<th>Before implementation, % (N = 100)</th>
<th>After implementation, % (N = 100)</th>
<th>(P) value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Snoring</td>
<td>13</td>
<td>19</td>
<td>.33</td>
</tr>
<tr>
<td>Tiredness</td>
<td>3</td>
<td>11</td>
<td>.048</td>
</tr>
<tr>
<td>Observed apnea(^a)</td>
<td>1.7</td>
<td>11</td>
<td>.033</td>
</tr>
<tr>
<td>High blood Pressure</td>
<td>7</td>
<td>19</td>
<td>.019</td>
</tr>
<tr>
<td>BMI (\geq 35) kg/m(^2)</td>
<td>3</td>
<td>6</td>
<td>.49</td>
</tr>
<tr>
<td>Age &gt; 50 years</td>
<td>8</td>
<td>20</td>
<td>.023</td>
</tr>
<tr>
<td>Neck circumference &gt; 40 cm(^a)</td>
<td>2.3</td>
<td>5</td>
<td>.66</td>
</tr>
<tr>
<td>Gender male</td>
<td>70</td>
<td>66</td>
<td>.65</td>
</tr>
<tr>
<td>STOP-BANG score (0-8)</td>
<td></td>
<td></td>
<td>.001</td>
</tr>
<tr>
<td>&lt; 3</td>
<td>95</td>
<td>79</td>
<td></td>
</tr>
<tr>
<td>(\geq 3)(^b)</td>
<td>5</td>
<td>21</td>
<td></td>
</tr>
<tr>
<td>Median (range)</td>
<td>1 (0-4)</td>
<td>1 (0-5)</td>
<td></td>
</tr>
<tr>
<td>Mean ± SD</td>
<td>1.06 ± 0.7</td>
<td>1.57 ± 1.26</td>
<td></td>
</tr>
</tbody>
</table>

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\(^a\)Only 59 had information on apnea symptoms and 44 patients had information on neck circumference out of 100 charts reviewed at baseline.

\(^b\)A patient was at high risk of OSA if STOP-BANG questionnaire score was 3 or higher.
iatric or total joint replacement surgery. Because the study was completed at an overseas military hospital in Japan, the results may not be generalizable to other populations.

An additional limitation is that polysomnography was not performed in patients who scored 3 or higher on the STOP-BANG Questionnaire. The reason for obtaining preoperative polysomnography is to confirm the diagnosis of OSA, which allows for the initiation of continuous positive airway pressure (CPAP) therapy. Obtaining preoperative polysomnography is expensive and difficult to obtain, especially in an overseas military hospital. A recent randomized controlled trial demonstrated that CPAP initiated before surgery and continued after surgery significantly reduced postoperative AHI events; however, compliance was poor. In that trial, Liao et al randomly assigned 177 patients with newly diagnosed moderate to severe OSA (AHI ≥ 15) to autotitrated CPAP initiated 2 or 3 days before surgery and continued for 5 days after surgery or usual care. They found that autotitrated CPAP decreased the mean AHI from 30 to 3 events on postoperative night 3; unfortunately, the compliance rate was only 45%, with 26% to 48% using CPAP therapy for at least 4 hours per night postoperatively. The most common reason for noncompliance was pain and/or postoperative nausea and vomiting (73%).

Finally, we retrospectively measured the prevalence of OSA over only 1 month before and after implementation. Variability in patient characteristics and surgical procedure may change from month to month. For example, before implementation we identified 6 patients with a self-reported diagnosis of OSA and only 1 after implementation. We acknowledge that these baseline differences and lack of control may weaken our results and do not allow us to determine causality; however, our prevalence rate of OSA (21%) was consistent with results of Finkel et al and Chung et al; therefore, we believe this rate is a more accurate reflection of the patients who may be at risk of OSA at our institution. Future projects should evaluate the prevalence of OSA over a longer time.

- Implications for Practice Recommendations. For hospitals considering implementing use of the STOP-BANG Questionnaire, it is recommended that preoperative nurses receive OSA education training during their orientation period and annually. For example, at many military hospitals, nurses are required to complete annual competency refresher training. We believe this would be the ideal time to refresh their memory on the OSA screening protocol and scoring of the STOP-BANG Questionnaire. Furthermore, there is high turnover of military nurses because they are usually required to transfer to a new military hospital every 3 years.

Implementation of the STOP-BANG Questionnaire may increase the workload (need for preoperative anesthesia consultation), and trigger a need for a higher level of care and costs (ie, overnight admission, use of continuous end-tidal carbon dioxide [ETCO₂], or pulse oximetry) depending on facility policies. Recent research on the STOP-BANG Questionnaire suggests a cut score of 5 and above may be more sensitive at identifying patients with moderate to severe OSA. Patients with moderate to severe OSA are at the greatest risk of perioperative complications. Investigators at Vanderbilt University reported how they incorporated the STOP-BANG Questionnaire into their Perioperative Information Management System. They decided to use a cut score of 5 or greater to flag patients at high risk because a threshold of 3 and above was overly inclusive and resulted in excessive workload. The most common complaint by staff was the increased time it took to measure neck circumference.

As more anesthesia departments start using electronic medical records and anesthesia information management systems, consideration should be given to include the STOP-BANG Questionnaire, to set the system up to automatically flag patients at high risk of OSA, and to offer some guidelines for management. Other options may be to place an armband on a patient indicating he or she may have OSA. Anesthesia departments should develop guidelines for preoperatively referring patients to a sleep medicine specialist to confirm OSA and initiate CPAP therapy for patients with OSA. Departments should develop guidelines identifying which patients may benefit from postoperative respiratory monitoring (ie, overnight stay in the postanesthesia care unit stay, continuous ETCO₂, and/or oxygen saturation measured by pulse oximetry [SpO₂]). Finally, anesthesia providers should consider referring patients with suspected OSA postoperatively for a sleep study.

Conclusion

After an educational intervention with preoperative nurses and preoperative forms redesign to incorporate the STOP-BANG Questionnaire, an increased proportion of patients at high risk of OSA were identified. Future research should explore if a higher score on the STOP-BANG Questionnaire (≥ 5) predicts worsening of postoperative OSA symptoms (ie, AHI, severity of oxygen desaturation levels).

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