ENDOSCOPY CORNER

A Screening Instrument for Sleep Apnea Predicts Airway Maneuvers in Patients Undergoing Advanced Endoscopic Procedures

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BACKGROUND & AIMS: Among patients undergoing advanced endoscopy, unrecognized obstructive sleep apnea (OSA) could predict sedation-related complications (SRCs) and the need for airway maneuvers (AMs). By using an OSA screening tool, we sought to define the prevalence of patients at high risk for OSA and to correlate OSA with the frequency of AMs and SRCs. **METHODS:** We enrolled 231 consecutive patients undergoing endoscopic retrograde cholangiopancreatography (ERCP) (n = 176) and endoscopic ultrasound (n = 55). Propofol-based sedation and patient monitoring were performed by a nurse anesthetist and an anesthesiologist. A previously validated screening tool for OSA (STOP-BANG) was used to identify patients at high risk for OSA (score, ≥3 of 8; SB+) or low risk (SB−). AMs were defined as a chin lift, modified mask ventilation, nasal airway, bag-mask ventilation, and endotracheal intubation. SRCs were defined as any duration of pulse oximetry less than 90%, systolic blood pressure less than 90 mm Hg, apnea, or early procedure termination. **RESULTS:** The prevalence of SB+ was 43.3%. The frequency of hypoxemia was significantly higher among patients with SB+ than SB− (12.0% vs 5.2%; relative risk [RR], 1.83; 95% confidence interval [CI], 1.32–2.54). The rate of AMs was also significantly higher among SB+ (20.0%) compared with SB− (6.1%) patients (RR, 1.8; 95% CI, 1.3–2.4). These rates remained significant after adjusting for American Society of Anesthesiologists class 3 or higher (RR, 1.70; 95% CI, 1.28–2.2 for AMs; RR, 1.63; 95% CI, 1.19–2.25 for hypoxemia). Each element of the STOP-BANG was reported more commonly in SB+ patients ($P < .0001$ for each comparison). **CONCLUSIONS: A significant number of patients undergoing advanced endoscopic procedures are at risk for OSA. AMs and hypoxemia occur at an increased frequency in these patients.**

Keywords: ERCP; EUS; Monitored Anesthesia Care; Interventional Endoscopy.

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Obstructive sleep apnea (OSA) is estimated to affect 2% to 4% of the middle-aged population.[1] Because the obesity rate among adults in the United States is greater than 30%, the prevalence of OSA may be 10% or higher.[2,3] Survey data from the United States suggest the OSA rate among obese adults could be as high as 25%.[4] In fact, some form of sleep-disordered breathing such as snoring is thought to affect up to 20% of adults. Despite these daunting estimates, up to 93% of females and 82% of males with OSA remain undiagnosed.[5] Patients with OSA are thought to have a greater risk for developing sedation-related complications (SRCs) during endoscopic procedures, but data confirming this hypothesis are lacking.[6]

Full polysomnography represents the gold standard for the diagnosis of OSA, in which patients are monitored extensively overnight while they sleep.[7] Unfortunately, polysomnography is time consuming, costly, and impractical to apply to a broad patient population. Although there are several screening instruments for OSA, the STOP-BANG questionnaire represents a highly sensitive bedside tool that is particularly useful to screen for patients with severe OSA (Supplementary Table 1).[8] STOP-BANG has been validated using polysomnography, and a positive score, defined as ≥3, has correlated with a higher rate of postoperative complications.[9] The Berlin questionnaire is an alternative screening tool for OSA that recently has been studied in patients undergoing standard endoscopy; however, STOP-BANG appears to be superior to the Berlin questionnaire in predicting postoperative complications when applied to a population of preoperative patients.[8–11]

Moderate or deep sedation in endoscopy using midazolam lowers the threshold for upper airway obstruction, particularly among obese patients.[12,13] Initially approved for the induction and maintenance of anesthesia, propofol (2,6-diisopropofol) has become an increasingly popular sedative for endoscopic procedures because of its rapid onset of action (30–45 seconds) and short duration of effect (4–8 minutes).[14,15] The safe administration of propofol by nonanesthesiologists in low-risk patient populations undergoing standard endoscopy has been bolstered by a recent publication reporting 11 cases of rescue endotracheal intubation among 569,220 endoscopies.[16] Propofol accentuates airway collapse as patients become unresponsive to verbal stimulation (ie, deep sedation).[17] The relative risk for

Abbreviations used in this paper: AM, airway maneuver; ASA, American Society of Anesthesiologists; BMI, body mass index; CI, confidence interval; CRNA, certified registered nurse anesthetist; ERCP, endoscopic retrograde cholangiopancreatography; EUS, endoscopic ultrasound; MOAA/S, Modified Observer's Assessment of Alertness and Sedation; OSA, obstructive sleep apnea; RR, relative risk; SRC, sedation-related complication.

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SRCs of a propofol-based regimen compared with the standard combination approach in patients with OSA undergoing standard or advanced endoscopic procedures is unclear.

Among patients undergoing advanced endoscopic procedures such as endoscopic ultrasound (EUS) and endoscopic retrograde cholangiopancreatography (ERCP), the risk for airway complications is thought to be higher compared with standard endoscopy owing to longer procedure times and the need for relatively deeper levels of sedation. There is limited information on specific clinical predictors of developing SRCs during advanced endoscopy.[18–20] We previously showed a correlation between patients with a higher body mass index (BMI) and an increased frequency of needing airway manipulation during advanced endoscopic procedures.[18] We hypothesized that a bedside screening instrument for OSA would help to identify high-risk patients for SRCs and those who require airway maneuvers (AMs) during advanced endoscopy.

Methods

We performed a prospective cohort study of patients undergoing ERCP or EUS in the endoscopy unit at Washington University in St. Louis. The protocol was approved by our local Human Research Protection Office. Consecutive patients undergoing ERCP and EUS were enrolled between December 2008 and October 2009. Propofol-based sedation and patient monitoring were performed by a certified registered nurse anesthetist (CRNA) under the medical direction of an anesthesiologist. Our routine practice is to sedate patients undergoing advanced procedures using propofol alone or in combination with low-dose opiate and/or benzodiazepine. We previously published our experience using this approach in 799 patients undergoing advanced endoscopic procedures.[18]

Before the procedure, patients are examined by an anesthesiologist with extensive experience in sedating patients in a tertiary care endoscopy unit. For induction, the use of propofol alone or in combination with low-dose benzodiazepine and/or opiate is left to the discretion of the CRNA. Sedative dosing is adjusted to maintain at least deep sedation throughout the procedure. A team of 1 anesthesiologist and 3 CRNAs, all with extensive experience sedating patients for advanced endoscopic procedures, participated in this study. The anesthesiologist obtained informed consent and enrolled patients in the endoscopy unit at the time of preprocedure evaluation. Other than prior documentation of OSA and the inability to give informed consent, there were no exclusion criteria. We intentionally did not exclude patients based on clinical characteristics that could predict SRCs such as morbid obesity and American Society of Anesthesiologists (ASA) class of 3 or higher.[21]

STOP-BANG

A previously validated screening tool, STOP-BANG, was administered by the anesthesiologist to assess OSA risk before the procedure. The instrument is composed of 4 questions and 4 clinical characteristics (age >50 y; male sex; BMI >35 kg/m^2; and neck circumference >40 cm). Scores of 3 or higher out of 8 have high sensitivity and negative predictive value for moderate to severe OSA.[8] Specifically, a score of 3 or greater has a sensitivity of 83.6% for patients who have an apnea-hypopnea index greater than 5 on subsequent full polysomnography; the sensitivity increases to 92.9% for those with an apnea-hypopnea index greater than 15, which correlates with moderate to severe OSA. The results of STOP-BANG were not disclosed to the sedating CRNA or treating endoscopist, so the results would not be expected to impact on the approach to sedation.

Patient Monitoring

All patients underwent continuous electrocardiography and heart rate, pulse oximetry, nasal capnography, and intermittent blood pressure monitoring during the procedure. If nasal capnography suggested hypopnea/apnea (defined as <6 breaths/min), the CRNA evaluated for airway patency and chest expansion before intervening. In addition, the CRNA moved the nasal cannula in front of the oropharynx to assess end tidal CO_2. The CRNA used all of these variables in assessing for the presence of hypopnea/apnea. Supplemental oxygen by nasal cannula (3 L/min) was provided to all patients at the onset of sedation. Administration of propofol and other sedatives was determined solely by the CRNA, who had no other involvement in the procedure except to monitor the patient. Patients undergoing ERCP were typically in the prone position whereas those undergoing EUS were in the left lateral decubitus position. Depth of sedation was assessed by the sedating CRNA using the Modified Observer's Assessment of Alertness/Sedation (MOAA/S) score at the time of endoscopic intubation, a previously validated quantitative measure of sedation depth.[22]

Airway Maneuvers and Sedation-Related Complications

We deliberately separate SRCs and AMs for analysis. AMs reflect active airway problems during the sedation period that require one or more interventions whereas SRCs typically reflect the end point of unsuccessful AMs and adjustments to the sedation regimen to maintain patient stability. AMs were defined a priori as a chin lift maneuver, nasopharyngeal airway, modified mask airway, positive pressure ventilation (also called *bag-mask ventilation*), or endotracheal intubation. We classified a chin lift as any manipulation of the chin or a jaw thrust maneuver to improve upper airway patency for optimal airflow. A modified mask airway was defined as the use of a customized oxygen delivery system that permitted a higher fraction of inspired oxygen compared with a nasal cannula without interfering with the endoscope. A nasopharyngeal airway involved the insertion of a tube through a nostril and into the nasopharynx to prevent the tongue from blocking air flow. Positive pressure ventilation and endotracheal intubation were reserved for patients who did not respond to less-invasive AMs along with alterations in the sedation regimen. AMs were performed solely at the discretion of the CRNA for laryngospasm, upper airway obstruction, hypoxemia, and hypopnea/apnea (defined as <6 breaths/min), which may have occurred with or without hypoxemia. Of note, all patients with hypoxemia required one or more AMs, but not all patients who required an AM necessarily developed hypoxemia or other SRC. The anesthesiologist does not routinely assist in the decision to implement or implementation of AMs, with the exception of endotracheal intubation.

SRCs included hypoxemia (defined as a pulse oximetry <90% for any duration); hypotension, defined as a systolic blood pressure of less than 90 mm Hg or a decrease of more than 25% from baseline; or hypopnea/apnea, defined as fewer

than 6 breaths/min based on capnography. Early procedure termination for an alternative SRC (eg, refractory laryngospasm) also was recorded.

Analysis Plan

By using a STOP-BANG score of 3 or higher for high risk as recommended by Chung et al,[8] patients were dichotomized into high risk (SB+) and low risk (SB−) for OSA groups. Our primary outcomes were 2-fold: (1) to define the frequency of SB+ patients at an advanced endoscopy referral center and, (2) to compare the rate of AMs and SRCs between SB+ and SB− groups. Rates are reported as simple proportions (percentages) and standard comparative analyses performed using chi-square testing. The incremental risks of AMs and SRCs in SB+ patients are reported as relative risks (RRs) and corresponding 95% confidence intervals (CIs). In addition to any SRC, we calculated the RR for developing hypoxemia specifically because we consider this SRC most closely linked to underlying OSA risk. Demographic, procedural, and pharmacologic characteristics were compared between groups using the chi-square test for dichotomous variables and unpaired *t* testing or the Mann–Whitney test for continuous variables. We then calculated an adjusted RR to correct for ASA class of 3 or higher using the Mantel–Haenszel stratification method. Finally, we present simple proportions to report the frequency of a positive response to each element of the STOP-BANG.

Sample size estimates were based on the anticipated rate of AMs in SB+ and SB− patients. We assumed the rate of AMs would be 15% based on prior experience,[18] and estimated this rate would increase to 25% for patients with an SB+ and decrease to 10% for SB− patients. Enrolling 226 patients would give us 80% statistical power to detect a significant difference in the frequency of AMs with a 2-sided α error of .05. Statistical analyses were completed using Stata version 10.0 (StataCorp LP, College Station, TX).

Results

During the study period, 231 patients who met our inclusion/exclusion criteria were enrolled, including 176 (76%) patients undergoing ERCP and 55 (24%) patients undergoing EUS. No patients refused to participate. The prevalence of a STOP-BANG score of 3 or higher (ie, SB+) was 43.3% (100 of 231). Patient, procedure, and pharmacologic characteristics are summarized in Table 1, stratified by OSA risk. As expected (because age, BMI, and male sex are components of the STOP-BANG assessment tool), SB+ patients were significantly older, predominantly male, and had higher BMIs compared with the SB− group. Prone positioning was used less frequently and patients had a significantly higher MOAA/S score (ie, they were not sedated as deeply in the SB+ compared with the SB− group) at the time of endoscopic intubation, although the clinical relevance of this numeric difference is unclear. MOAA/S scores of less than 1 are typically associated with a depth of sedation equivalent to general anesthesia. The use of combination regimens and propofol infusion time were similar in both groups. However, weight-based induction and total propofol doses were significantly less in the SB+ group.

The frequency of AMs and SRCs is reported in Table 2. Twenty-eight of 231 (12.1%) patients required one or more AMs; of these, there were 3 cases of positive pressure ventilation for apnea (2 cases) and upper airway obstruction (1 case). There were no cases of endotracheal intubation in the entire cohort. The RR of a patient needing at least one AM was significantly higher among SB+ patients (20%) compared with the SB− group (6.1%) (RR, 1.81; 95% CI, 1.36–2.42). The adjusted risk remained statistically significant after modifying for ASA class of 3 or higher (RR, 1.70; 95% CI, 1.28–2.24).

SRCs occurred in 52 (22.5%) patients, primarily hypotension (15.6%) and hypoxemia (6.9%). Other SRCs included premature termination of the procedure in 2 patients (0.9%) for refractory laryngospasm and apnea in 2 (0.9%) others. The only cases of apnea (2) occurred in SB+ patients. Among SB+ patients, the

Table 1. Patient and Procedural Characteristics, Stratified by Risk for OSA (n = 231)

Variable	SB+ (n = 100)	SB− (n = 131)	*P* value
Patient characteristics			
Mean age ± SD, *y*[a]	60.3 ± 12.7	50.1 ± 17.2	<.0001
% Male sex (95% CI)[a]	73.0 (64.3–81.7)	26.7 (19.1–34.3)	<.0001
Mean BMI ± SD[a]	31.4 ± 7.8	26.1 ± 6.3	<.0001
% ASA ≥3 (95% CI)	74.0 (65.4–82.6)	50.4 (41.8–58.9)	.0003
Mallampati score, median (IQR)	2 (1–3)	2 (1–2)	<.003[b]
STOP-BANG score, median (IQR)	4 (3–4)	1 (1–2)	<.0001[b]
Procedural data			
Mean endoscopy time ± SE, min	28.5 ± 24.7	31.1 ± 22.7	.39
Prone position, % (95% CI)	57.0 (47.2–66.7)	70.2 (62.4–78.1)	.04
MOAA/S score at endoscopic intubation, median (IQR)	0 (0–0)	0 (0–0)	.02[b]
MOAA/S during the procedure, median (IQR)	0 (0–0)	0 (0–0)	.10[b]
Pharmacologic data			
Concomitant use of benzodiazepine and/or opiate, %	50.0 (40.2–59.8)	56.5 (48.0–65.0)	.33
Mean induction propofol dose ± SE, *mg/kg*	2.1 ± 1.1	3.0 ± 1.4	<.0001
Mean total propofol dose ± SE, *mg/kg*	6.5 ± 4.7	9.1 ± 6.3	.0006
Mean propofol infusion time ± SE, *min*	35.2 ± 25.8	37.9 ± 23.1	.40

IQR, interquartile range; SD, standard deviation; SE, standard error of the mean.
[a]Age >50, male sex, and BMI >35 kg/m^2 are components of the STOP-BANG assessment.
[b]Two-sample, Wilcoxon rank-sum (Mann–Whitney) test.

Table 2. Use of Airway Maneuvers and Prevalence of SRCs

Complication/intervention	SB+, % (n = 100)	SB−, % (n = 131)	Total, % (n = 231)	Unadjusted RR (95% CI)	Adjusted RR[a] (95% CI)
AMs					
Any AM[b]	20 (20.0)	8 (6.1)	28 (12.1)	1.81 (1.36–2.42)	1.70 (1.28–2.24)
Chin lift maneuver	12 (12.0)	6 (4.6)	18 (7.8)		
Modified mask airway	12 (12.0)	6 (4.6)	18 (7.8)		
Nasal airway	10 (10.0)	2 (1.5)	12 (5.2)		
Bag-mask ventilation	3 (3.0)	0 (0.0)	3 (1.3)		
Endotracheal intubation	0 (0.0)	0 (0.0)	0 (0.0)		
SRCs					
Any SRC[b]	26 (26.0)	27 (21.4)	53 (22.9)	1.18 (0.85–1.63)	1.14 (0.83–1.56)
Hypoxemia (pulse oximetry <90%)	12 (12.0)	4 (5.2)	16 (6.9)	1.83 (1.32–2.54)	1.63 (1.19–2.25)
Apnea (determined by CRNA)	2 (2.0)	0 (0.0)	2 (0.9)		
Hypotension (SBP <90 or >25% decline from baseline)	14 (14.0)	22 (16.8)	36 (15.6)		
Procedure termination	0 (0.0)	2 (1.5)	2 (0.9)		

SBP, systolic blood pressure.
[a]Adjusted for ASA class ≥3.
[b]Any AM and SRC are described on a per-patient basis. That is, 28 patients required at least one AM and 52 had at least one SRC. However, because more than one AM or SRC could occur in each patient, the total number of AMs does not add up to 28. AMs and SRCs were not counted more than once if the same maneuver was repeated on a patient.

frequency of having at least one SRC was not significantly higher (RR, 1.18; 95% CI, 0.85–0.63). However, if SRCs were limited to cases of hypoxemia (an SRC that more likely is associated with OSA), the RR was significantly higher among SB+ patients (1.83; 95% CI, 1.32–2.54). This remained statistically significant after adjusting for ASA class of 3 or higher (RR, 1.63; 95% CI, 1.19–2.25).

Responses to each element of the STOP-BANG assessment are summarized in Figure 1. As expected, each component of the STOP-BANG was present more frequently among SB+ patients ($P < .0001$ for each comparison).

Discussion

The obesity problem in the United States is staggering. In 2008, only one state (Colorado) reported an obesity prevalence of less than 20% and 32 states reported a prevalence of 25% or greater.[23] With these rates increasing each year, the frequency of undetected OSA is expected to increase. In our cohort of patients referred to an academic medical center for advanced endoscopic procedures, the prevalence of a positive score using STOP-BANG was 43.3%. Nevertheless, all patients were sedated using a propofol-based regimen with no

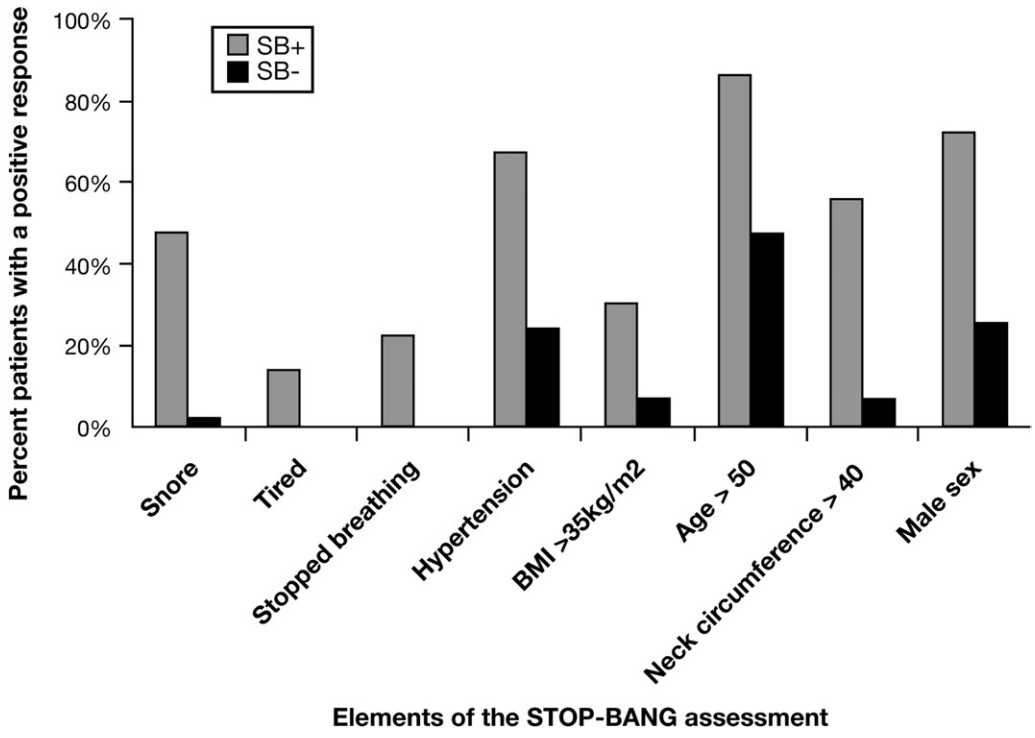

Figure 1. Positive responses to each element of the STOP-BANG screening instrument for OSA. The prevalence of each STOP-BANG element was significantly more common among SB+ patients ($P < .0001$ for each comparison).

cases requiring endoscopic intubation. Although the overall rate of AMs and SRCs were 12% and 23%, respectively, most of these would be considered minor; there were only 2 cases of premature procedure termination and 3 patients who required bag-mask (also called *positive pressure*) ventilation transiently.

Each of the 8 components to STOP-BANG were represented more commonly in the SB+ group, and daytime fatigue as well as witnessed apnea were reported only among SB+ patients. Patients with a positive STOP-BANG required more AMs and had more frequent airway-related SRCs including hypoxemia and apnea. Although we did not detect a statistically significant difference in the relative rate of all SRCs after adjusting for ASA class, our sample size was underpowered for this outcome measure. Still, the rate of AMs and hypoxemia remained significantly higher after adjusting for ASA class of 3 or higher, a previously described risk factor for SRCs.[24] Despite these less favorable results in SB+ patients, this higher-risk subgroup received relatively less sedation (in terms of induction and total doses of propofol) and was not as deeply sedated compared with SB− patients, based on the MOAA/S score at the time of endoscopic intubation. Both groups met criteria for deep sedation or greater, based on an MOAA/S score of less than 1. Finally, prone positioning was used less frequently in SB+ patients because of limitations related to their body habitus. Of the 176 ERCP cases, 9 of 101 SB− (8.9%) compared with 18 of 75 (24%) of SB+ were performed in the left lateral decubitus position. In our experience, prone positioning does not appear to be an independent predictor of SRCs or AMs; however, this has not been studied in a prospective fashion.[18] Among SB+ patients, the frequency of hypoxemia, any AM, or any SRC was not significantly different in patients who underwent their procedure in the prone position (data not shown). Although the sedating CRNA was unaware of the patient's STOP-BANG score, their preprocedure airway evaluation likely impacted on the decision to position a minority of ERCP cases in the left lateral decubitus position. Nevertheless, the lower induction and total propofol doses along with the lower frequency of prone positioning in SB+ patients likely impacted on the rate of AMs and SRCs in this higher-risk subgroup.

Our results contradict Khiani et al,[11] who did not detect a correlation between positive scores using the Berlin questionnaire and higher rates of hypoxemia in patients undergoing standard endoscopic procedures (upper endoscopy and colonoscopy). There are several explanations for this. First, the majority (67%) of patients in the Khiani et al[11] trial underwent colonoscopy alone, for which the depth of sedation and impact on the upper airway are presumably less than ERCP and EUS. Their sedation approach (non–propofol-based) also was distinct. In addition, the Berlin questionnaire originally was designed for a primary care patient population whereas STOP-BANG originally was validated in a preprocedure (ie, surgical or endoscopic) patient population.[8–10] Patients undergoing advanced endoscopic procedures are more likely to represent a surgical patient population whereas those undergoing standard endoscopy (eg, in the Khiani et al[11] study) are akin to a primary care population. The increased sensitivity of STOP-BANG in a surgical cohort may account for our improved correlation with SRCs. Finally, hypoxemia (the primary outcome measure in the Khiani et al[11] trial) represents the end point of suboptimal ventilation as a result of apnea, upper airway obstruction, or poor alveolar air exchange, among others. We prefer the outcome measure of AMs in favor of hypoxemia or other SRCs because the use of AMs quantifies the need for active airway monitoring and manipulation during the endoscopy as a result of suboptimal airflow. Although an AM may not be a true complication, it unequivocally highlights the importance of a having a provider who is solely responsible for airway management during the endoscopy.[25] In our cohort, 20% of SB+ patients required at least one AM, compared with 6% in the SB− group.

There were limitations of this analysis. First, we did not confirm the presence of OSA using polysomnography in those patients with a STOP-BANG score of 3 or higher; therefore, we cannot define the actual rate of OSA but only the prevalence of those at high risk. However, Chung et al[8] previously reported a positive predictive value of 81% for a positive STOP-BANG score, so a majority of SB+ patients in our cohort are considered likely to have a positive polysomnography study. Our patient population represents a unique subgroup undergoing advanced endoscopy at a tertiary referral center, with the majority having an ASA score of 3 or higher, older age, and a high rate of obesity. In addition, we have a dedicated anesthesiologist in the endoscopy unit along with 3 CRNAs, each of whom previously has sedated more than 2000 patients undergoing ERCP or EUS. Patients in both OSA risk groups were deeply sedated, with mean MOAA/S scores of less than 1 at the time of endoscopic intubation. These providers undoubtedly are skilled, and their complication and AM rates are unlikely to reflect those of a less-experienced provider. Along these lines, our use of capnography also may have reduced our rate of SRCs, particularly among obese patients, as reported in a recent randomized clinical trial using capnography in patients undergoing ERCP and EUS.[26]

BMI is an independent predictor of AMs and SRCs among patients undergoing standard and advanced endoscopic procedures.[18,26,27] In addition, an increased BMI is a reliable predictor of OSA.[28] However, data in the endoscopic literature are lacking on the clinical significance of undetected OSA as a risk factor for SRCs.[29]

The use of STOP-BANG is an easy bedside screening tool that supplements previously validated instruments such as ASA class in identifying which patients are at highest risk for AMs and SRCs. With the ongoing debate regarding the safe administration of propofol by nonanesthesiologists, risk stratification before endoscopy is critical.[30] By incorporating several variables in a rapid bedside instrument, STOP-BANG complements the current approach to the preprocedure assessment and helps identify patients likely to encounter SRCs and require AMs during advanced endoscopic procedures.

Supplementary Material

Note: To access the supplementary material accompanying this article, visit the online version of *Clinical Gastroenterology and Hepatology* at www.cghjournal.org, and at doi:10.1016/j.cgh.2010.05.015.

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Conflicts of interest

The authors disclose no conflicts.

Supplementry Table 1. STOP-BANG Questionnaire

1. Do you **S**nore loudly (louder than talking or loud enough to be heard through closed doors)?
   Yes No
2. Do you often feel **T**ired, fatigued, or sleepy during daytime?
   Yes No
3. Has anyone **O**bserved you stop breathing during your sleep?
   Yes No
4. Do you have or are you being treated for high blood **P**ressure?
   Yes No
5. **B**MI > 35 kg/m^2? (BMI = _____)
   Yes No
6. **A**ge > 50 years
   Yes No
7. **N**eck circumference > 40 cm? (Neck circumference = _____cm)
   Yes No
8. **G**ender male?
   Yes No

NOTE. A score of 3 or greater denotes a high risk for obstructive sleep apnea.