OPEN

CURRENT OPINION

An update on the various practical applications of the STOP-Bang questionnaire in anesthesia, surgery, and perioperative medicine

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Purpose of review
The present review aims to provide an update on the various practical applications of the STOP-Bang questionnaire in anesthesia, surgery, and perioperative medicine.

Recent findings
The STOP-Bang questionnaire was originally validated as a screening tool to identify surgical patients who are at high-risk of obstructive sleep apnea (OSA). A recent meta-analysis confirmed that STOP-Bang is validated for use in the sleep clinic, surgical, and general population. Patients with a STOP-Bang score of 0–2 can be classified as low-risk for moderate-to-severe OSA. Those with a score of 5–8 can be classified as high-risk for moderate-to-severe OSA. In patients with a score of 3 or 4, a specific combination of a STOP score at least 2 + BMI more than 35 kg/m^2 or STOP score at least 2 + male or STOP score at least 2 + neck circumference more than 40 cm indicates higher risk for moderate-to-severe OSA. Further, patients with a STOP-Bang score at least 3 can be classified as high risk for moderate-to-severe OSA if the serum HCO_3^- at least 28 mmol/l. STOP-Bang can be used as a novel tool for perioperative risk stratification because it easily identifies patients who are at increased risk of perioperative complications.

Summary
STOP-Bang at least 3 was recommended previously to identify the suspected or undiagnosed OSA. To reduce the false positive cases and to improve its specificity, a stepwise stratification is recommended to identify the patients at high risk of moderate-to-severe OSA. Because of its practical application, STOP-Bang is a useful screening tool for patients with suspected or undiagnosed OSA.

Keywords
anesthesia, obstructive sleep apnea, perioperative medicine, screening, STOP-Bang questionnaire, surgery

INTRODUCTION

Obstructive sleep apnea (OSA) is a common sleep disordered breathing (SDB) characterized by upper airway collapse resulting in recurrent episodes of arousal from sleep and intermittent hypoxemia. The prevalence of OSA in surgical patients differs among various populations. The prevalence rate is 7–10% among patients undergoing a variety of surgeries [1], and approximately 70% in patients undergoing bariatric surgery [2,3]. Because 60% of patients with moderate-to-severe OSA were not recognized or diagnosed when they presented for surgery [4,5], the point estimates from these studies may be an underestimation.

OSA remains a significant problem despite the advances in perioperative care. The presence of OSA is associated with an increase in adverse postoperative outcomes in patients undergoing various types of elective surgeries [6,7,8■■]. It is important to note that OSA poses an economic burden, as it increases the length of hospital stay and healthcare costs [9,10]. As the majority of the surgical patients with

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KEY POINTS

- STOP-Bang is the most validated screening tool to identify surgical patients at high-risk of OSA.
- The higher the STOP-Bang score, the greater the probability of patients will have moderate-to-severe sleep apnea.
- Serum HCO_3^- level increases the specificity of STOP-Bang questionnaire in predicting moderate-to-severe OSA.
- The specificity to detect moderate-to-severe OSA increases based on the different combinations of STOP-Bang questionnaire (STOP $\geq$ 2 + BMI or STOP $\geq$ 2 + male or STOP $\geq$ 2 + neck circumference > 40 cm).
- To improve the specificity of STOP-Bang, a stepwise stratification is recommended to identify the patients at high-risk of moderate-to-severe OSA.

OSA are undiagnosed, the Society of Anesthesia and Sleep Medicine Guidelines on preoperative screening and preparation of patients with OSA strongly recommend the screening for OSA in the preoperative period [11■■]. Similarly, the American Society of Anesthesiologists makes the same recommendation [12■]. The STOP-Bang questionnaire is a validated screening tool to identify the patients with high-risk OSA during the perioperative period [13,14,15■■]. Using the STOP-Bang questionnaire, several studies found that patients who were at risk for OSA (STOP-Bang ≥3) had a higher rate of perioperative complications versus patients with low-risk OSA (STOP-Bang 0–2) [16–25]. The STOP-Bang questionnaire demonstrated a positive association between high-risk OSA (STOP-Bang ≥3) and increased risk of desaturation, critical care admission, and difficulty airway [20,26,27]. The STOP-Bang questionnaire [13], P-SAP score [1], Berlin questionnaire [28], and ASA checklist [28] are screening tests that were evaluated in the surgical population and found to have comparable accuracy (Table 1) [11■■]. The present review will focus on the updated STOP-Bang questionnaire and aims to provide an update on the various practical applications of the updated STOP-Bang questionnaire in anesthesia, surgery, and perioperative medicine. We will highlight how the specificity of STOP-Bang can be improved by specific combinations of various items of the tool, and the use of the updated STOP-Bang questionnaire to risk-stratify patients.

DIAGNOSIS OF OBSTRUCTIVE SLEEP APNEA

The diagnosis of OSA is confirmed by calculating the apnea–hypopnea index (AHI), the number of apnea and/or hypopnea episodes per hour, on an overnight polysomnography. An apnea is defined as a decrease in airflow by 80% of baseline for at least 10 s. A hypopnea is defined as a decrease in airflow by 50–80% of baseline for at least 10 s. These episodes may be characterized by oxyhemoglobin desaturation episodes of at least 3–4% with a duration of 10 s. The average number of such episodes per hour is defined as oxygen desaturation index [29]. Cutoffs for AHI have been used to define the severity of OSA. The American Academy of Sleep Medicine defines mild OSA as AHI 5 to less than 15 events/h, moderate OSA as AHI 15–30 events/h, and severe OSA as AHI more than 30 events/h [30].

STOP-Bang QUESTIONNAIRE

The STOP questionnaire includes four questions related to snoring, tiredness, observed apnea, and high blood pressure, and shows a moderately high level of sensitivity (65.6%) and specificity (60%)

Table 1. Comparison of OSA screening tools in surgical patients for AHI ≥5 events/h

	STOP-Bang questionnaire [13] (*n* = 177)	Berlin questionnaire [28] (*n* = 177)	ASA checklist [28] (*n* = 177)	P-SAP score [1] (*n* = 511)
Sensitivity	83.6 (75.8–89.7)	68.9 (59.8–76.9)	72.1 (63.3–79.9)	93.9 (91.8–96.6)
Specificity	56.3 (42.3–69.6)	56.4 (42.3–69.7)	38.2 (25.4–52.3)	32.3 (23.2–46.7)
PPV[a]	81.0 (73.0–87.4)	77.9 (68.8–85.2)	72.1 (63.3–79.9)	10.0 (9.0–24.0)
NPV[a]	60.7 (46.1–74.1)	44.9 (32.9–57.4)	38.2 (25.4–52.3)	99.0 (98.0–99.0)
LR+	1.9 (1.40–2.61)	1.57 (1.17–2.36)	1.16 (0.94–1.51)	1.38 (1.37–1.39)
LR−	0.29 (0.18–0.46)	0.55 (0.39–0.79)	0.73 (0.47–1.13)	0.18 (0.16–0.21)
DOR	6.58 (3.03–14.36)	2.85 (1.48–5.50)	1.59 (0.81–3.13)	7.40 (6.48–8.45)
ROC	0.80	0.69	0.78	0.82

[a]Predictive values are highly dependent on the prevalence of OSA, which was 69% in the evaluation of STOP-Bang, Berlin, and ASA checklist, and 7.1% for the P-SAP score. AHI, apnea-hypopnea index; DOR, diagnostic odds ratio; LR+, positive likelihood ratio; LR−, negative likelihood ratio; NPV, negative predictive value; OSA, obstructive sleep apnea; PPV, positive predictive value; ROC, area under receiver operating characteristic curve. Adapted with permission from [11■■].

in detecting OSA (AHI >5 events/h) in surgical patients. For moderate-to-severe OSA (AHI >15 events/h), the sensitivity and specificity of the STOP questionnaire are 74 and 53%. For severe OSA (AHI >30 event/h), sensitivity is 80% and specificity is 49% [13].

The STOP-Bang questionnaire includes the four questions used in the STOP questionnaire, and four additional demographic queries, for a total of eight dichotomous (yes/no) questions related to the clinical features of sleep apnea (snoring, tiredness, observed apnea, high blood pressure, BMI, age, neck circumference and male sex). It is the most validated screening tool to identify surgical patients at high-risk of OSA [13,15▪▪,31]. The total score ranges from 0 to 8. Patients can be classified for OSA risk based on their respective scores (Fig. 1).

STOP-Bang can be completed quickly and easily (1–2 min), and the overall response rates are high (90-100%). The questionnaire has demonstrated a high sensitivity using a cut-off score at least 3: 84% in detecting any sleep apnea (AHI ≥5 events/h), 93%

Updated STOP-Bang Questionnaire:

1. **Snoring?**
   Do you **Snore Loudly** (loud enough to be heard through closed doors or your bed-partner elbows you for snoring at night)?
   - Yes/No

2. **Tired?**
   Do you often feel **Tired, Fatigued, or Sleepy** during the daytime (such as falling asleep during driving or talking to someone)?
   - Yes/No

3. **Observed?**
   Has anyone **Observed** you **Stop Breathing** or **Choking/Gasping** during your sleep?
   - Yes/No

4. **Pressure?**
   Do you have or are you being treated for high blood pressure?
   - Yes/No

5. **Body Mass Index more than 35 kg/m^2?**
   - Yes/No

6. **Age older than 50?**
   - Yes/No

7. **Neck size large? (Measured around Adams apple)**
   For male, is your shirt collar 17 inches/43 cm or larger?
   For female, is your shirt collar 16 inches/41 cm or larger?
   - Yes/No

8. **Gender: male?**
   - Yes/No

Scoring criteria:

Low-risk OSA: Score: 0,1,2

Intermediate-risk OSA: Score 3,4

High-risk OSA: Score 5,6,7,8

- or a STOP score ≥ 2 + male gender
- or a STOP score ≥ 2 + BMI > 35 kg/m^2
- or a STOP score ≥ 2 + neck circumference (Male: 17"/43cm; Female 16"/41cm)

FIGURE 1. Updated STOP-Bang questionnaire for screening OSA. In STOP-Bang, one point is scored for each positive answer. The total score ranges from 0 to 8. Patients can be classified for OSA risk based on their respective scores. Proprietary to University Health Network. Adapted with permission from [13,31,35▪▪].

in detecting moderate-to-severe sleep apnea (AHI ≥15 events/h), and 100% in detecting severe sleep apnea (AHI ≥30 events/h). The corresponding specificities were 56.4, 43, and 37% [13].

ASSOCIATION BETWEEN THE STOP-Bang SCORES AND THE PREDICTIVE PROBABILITY OF OBSTRUCTIVE SLEEP APNEA

In STOP-Bang, one point is scored for each positive answer and a score of 3 or greater is 84% sensitive and 56% specific for the presence of OSA (AHI > 5 events/h). The high sensitivity makes it an attractive screening tool as a score 0, 1 or 2 allows OSA to be confidently excluded. However, the modest specificity means a high proportion of those ruled in (score ≥3) may be false positives [13]. This may result in additional perioperative monitoring, unnecessary referral to sleep clinics for polysomnography, and increased resource utilization. To overcome these problems effectively and to decrease the healthcare expenses, two studies investigated the relationship between STOP-Bang scores and the predicted probability of OSA specifically in surgical patients [31,32]. In this pooled surgical population ($n=957$), the probability of moderate-to-severe OSA for a score of 3 is 40%. With a stepwise increase of the STOP-Bang score to 4, 5, 6, and 7/8, the probability increases proportionally to 48, 60, 68, and 80%, respectively (Fig. 2). With a stepwise increase of the STOP-Bang score of 4, 5, 6, and 7/8, the probability of severe OSA escalates to 25, 35, 45, and 65%, respectively (Fig. 2) [15■■]. A higher STOP-Bang score reflects a higher cumulative score of the known risk factors and the greater the probability of moderate-to-severe (AHI >15) and severe sleep apnea (AHI >30).

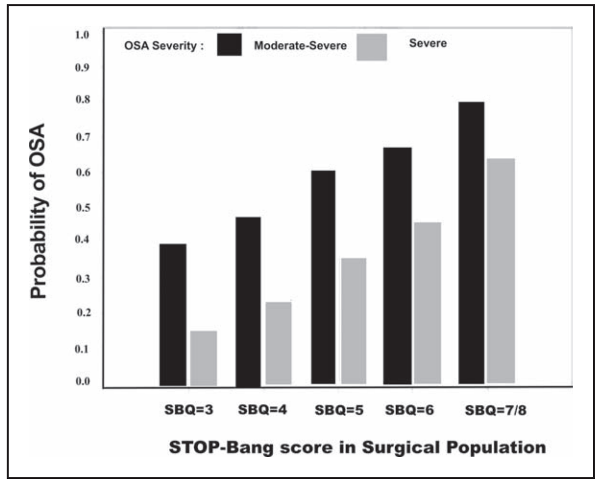

FIGURE 2. Probability of obstructive sleep apnea in surgical population. The relationship between STOP-Bang score and the probability of moderate-severe OSA (AHI ≥15) and severe OSA (AHI ≥30) in surgical patients. With a stepwise increase of the STOP-Bang score to 3, 4, 5, 6, and 7/8, the probability of moderate-to-severe (AHI ≥15) and severe OSA (AHI ≥30) increases proportionally. OSA, obstructive sleep apnea; SBQ, STOP-Bang questionnaire; Modified with permission from [15■■].

THE STOP-Bang QUESTIONNAIRE AND SERUM BICARBONATE

Serum HCO_3^- level increases the specificity of STOP-Bang questionnaire in predicting moderate-to-severe OSA, thereby decreasing the false positive cases. Nocturnal intermittent hypercapnia because of obstructive apnea or hypopnea may lead to renal HCO_3^- retention to compensate for respiratory acidosis. This may subsequently result in an elevated serum HCO_3^-. Serum HCO_3^- has been shown to be significantly correlated to AHI [33].

The addition of serum HCO_3^- at least 28 mmol/l to a STOP-Bang score at least 3 improves the specificity to predict moderate-to-severe OSA, but decreases its sensitivity [14]. Using a STOP-Bang score of at least 3 + HCO_3^- at least 28 mmol/l, the specificity for detecting moderate-to-severe OSA increases from 30 to 82%, and for severe OSA 28 to 80%, respectively (Table 2) [33]. Obesity hypoventilation syndrome (OHS) is defined by the triad of obesity, sleep-disordered breathing, and daytime hypoventilation in the absence of neuromuscular, mechanical, or metabolic causes. In contrast to patients with obesity hypoventilation syndrome, patients with OSA have less severe degree of sleep hypoventilation. Further, daytime hypoventilation is absent in patients with OSA. Because of these reasons, as the severity of OSA increases, there is only a mild elevation in the serum HCO_3^- compared to patients with severe OSA with obesity (BMI ≥ 50 kg/m^2), hypoxemia ($SaO_2 < 90\%$) during wakefulness and serum HCO_3^- at least 27 mmol/l should lead clinicians to suspect obesity hypoventilation syndrome [34].

ALTERNATIVE MODELS FOR SCORING THE STOP-Bang QUESTIONNAIRE

Alternative models for scoring STOP-Bang may be used to decrease the false positive cases. The eight items on STOP-Bang do not share an equal predictive weight for OSA [13]. For ease of scoring, all items on STOP-Bang are treated equally using a count of 0 or 1. The predictive performance of specific combinations of items has been explored [35■■]. The specificity to detect moderate-to-severe OSA

Table 2. Predictive value[a] of STOP-Bang plus serum various HCO_3^- level

Cut-off	STOP-Bang ≥3	STOP-Bang ≥3 + HCO_3^- ≥26	STOP-Bang ≥3 + HCO_3^- ≥27	STOP-Bang ≥3 + HCO_3^- ≥28	STOP-Bang ≥3 + HCO_3^- ≥29	STOP-Bang ≥3 + HCO_3^- ≥30
AHI > 5						
Sensitivity, %	82.6 (75.2–88.5)	52.9 (44.2–61.5)	41.3 (33.0–50.0)	30.4 (22.9–38.8)	17.4 (11.5–24.8)	7.2 (3.5–12.9)
Specificity, %	37.0 (24.3–51.3)	64.8 (50.6–77.3)	77.8 (64.4–88.0)	85.2 (72.9–93.4)	88.9 (77.4–95.8)	94.4 (84.6–98.8)
PPV, %	77.0 (69.4–83.5)	79.3 (69.6–87.1)	82.6 (71.6–90.7)	84.0 (70.9–92.8)	80.0 (61.4–92.3)	76.9 (46.2–95.0)
NPV, %	45.5 (30.4–61.2)	35.0 (25.7–45.2)	34.1 (25.8–43.2)	32.4 (24.8–40.8)	29.6 (22.7–37.3)	28.5 (22.0–35.7)
AHI > 15						
Sensitivity, %	88.3 (79.0–94.5)	62.3 (50.6–73.1)	49.4 (37.8–61.0)	37.7 (26.9–49.4)	20.8 (12.4–31.5)	9.1 (3.7–17.8)
Specificity, %	30.4 (22.2–39.7)	61.7 (52.2–70.7)	73.0 (64.0–80.9)	81.7 (73.5–83.3)	87.8 (80.4–93.2)	94.8 (89.0–98.1)
PPV, %	45.9 (37.7–54.3)	52.2 (41.5–62.7)	55.1 (42.6–67.1)	58.0 (43.2–71.8)	53.3 (34.3–71.7)	53.8 (25.1–80.8)
NPV, %	79.5 (64.7–90.2)	71.0 (61.1–79.6)	68.3 (59.3–76.4)	66.2 (57.8–73.9)	62.3 (54.4–69.8)	60.9 (53.3–68.1)
AHI > 30						
Sensitivity, %	97.3 (85.8–99.9)	70.3 (53.0–84.1)	59.5 (42.1–75.3)	48.6 (31.9–65.6)	29.7 (15.9–47.0)	16.2 (6.2–32.0)
Specificity, %	27.7 (20.9–35.5)	57.4 (49.2–65.3)	69.7 (61.8–76.8)	79.4 (72.1–85.4)	87.7 (81.5–92.5)	95.5 (90.9–98.2)
PPV, %	24.3 (17.7–32.1)	28.3 (19.4–38.6)	31.9 (21.2–44.2)	36.0 (22.9–50.8)	36.7 (19.9–56.1)	46.2 (19.2–74.9)
NPV, %	97.7 (88.0–99.9)	89.0 (81.2–94.4)	87.8 (80.7–93.0)	86.6 (79.9–91.8)	84.0 (77.4–89.2)	82.7 (76.3–87.9)

[a]Data are presented as average (95% confidence interval).
AHI, apnea-hypopnea index; NPV, negative predictive value; PPV, positive predictive value.
Adapted with permission from [33].

increases based on the different combinations: 85% for a STOP score at least 2 + BMI more than 35 kg/m^2; 77% for a STOP score at least 2 + male and 79% for a STOP score at least 2 + neck circumference more than 40 cm. These specific combinations may be utilized to accurately identify patients with moderate-to-severe OSA. In telephone assessment or in areas where tape measure is not easily available, the combination of STOP score at least 2 + BMI more than 35 kg/m^2 and a STOP score at least 2 + male provide an alternate way of scoring.

TWO-STEP STRATEGY FOR PATIENTS AT INTERMEDIATE RISK FOR OBSTRUCTIVE SLEEP APNEA

If a patient scores 0, 1 or 2, he or she is at low-risk for OSA. Conversely, a patient with a score of 5, 6, 7 or 8 has a high probability of moderate-to-severe OSA. A two-step strategy could be used for patients who score 3 or 4 on the STOP-Bang questionnaire – indicating they are at intermediate risk for OSA [14] (Fig. 3) The second step is only performed for patients with STOP-Bang scores of 3 or 4. These patients can be further classified as a higher risk for moderate-to-severe OSA if a combination of a STOP score at least 2 + BMI more than 35 kg/m^2 or STOP score at least 2 + male or STOP score at least 2 + neck circumference more than 40 cm. If it is not possible to measure neck circumference, the BMI or gender should be used to further stratify patients who are at intermediate risk for OSA. Patients with STOP-Bang score at least 3 can be further classified as high-risk for moderate-to-severe OSA if the serum HCO_3^- is at least 28 mmol/L [14].

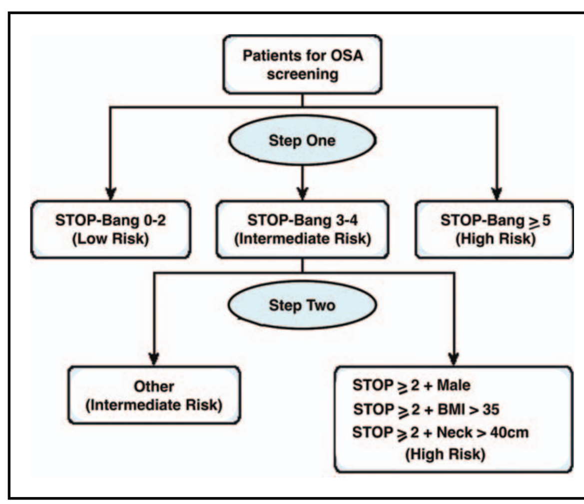

FIGURE 3. Two-step strategy for using STOP-Bang questionnaire. The first step is to check the STOP-Bang score to divide the patients into one of the three category (low-risk, intermediate-risk, or high-risk for OSA). The second step is for patients with STOP-Bang score of 3 or 4 to identify those at high-risk of moderate-to-severe OSA. OSA, obstructive sleep apnea; SBQ, STOP-Bang questionnaire. Adapted with permission from [14].

THE STOP-Bang QUESTIONNAIRE IN OBESE PATIENTS

The prevalence of OSA is very high in the obese population. A STOP-Bang score cut-off of 4 provides a better balance of sensitivity and specificity in the obese population [36]. In morbidly obese patients, a STOP-Bang score at least 4 retained a high sensitivity across the entire spectrum of OSA severity, with a sensitivity of 90% for detecting severe OSA, whereas a STOP-Bang score at least 6 demonstrated a specificity of 81% for detecting severe OSA [36].

STOP-Bang AND PERIOPERATIVE COMPLICATIONS

Several studies demonstrated the positive association of STOP-Bang scores with perioperative complications [16–25]. When compared to surgical patients with STOP-Bang scores 0, 1 or 2 (low risk of OSA), those with scores three or greater (high risk of OSA) had an increased rate of perioperative complications [19,21,25], respiratory complications [16,22,23], critical care admission [27], prolonged length of hospital stay [16,22,23], and 'one in four' chance of having an adverse event [19]. The increase in the rates of complications in patients at high risk of OSA justifies the implementation of perioperative strategies that use STOP-Bang as a tool for triage.

STOP-Bang AND ITS ASSOCIATION WITH MEDICAL DISEASES

Several studies have shown that high-risk OSA (STOP-Bang $\geq$3) patients identified by the STOP-Bang questionnaire have higher BMI [18,23], higher ASA physical status [16,18,23], and increased comorbidities [16,18,23,37]. High-risk OSA (STOP-Bang $\geq$3) patients were older, had higher incidence of ischemic heart disease, heart failure, hypertension, dyslipidemia, arrhythmia, chronic obstructive pulmonary disease, hypothyroidism and diabetes mellitus [16,18,23,37]. Screening with STOP-Bang and the knowledge of the association of OSA and comorbid diseases may decrease the rate of perioperative complications thus improving patients' safety.

STOP-Bang AND POSTOPERATIVE MORTALITY

Lockhart *et al.* used the STOP-Bang questionnaire and found that there was no significant difference in 30-day postoperative mortality between the low-risk and high-risk for patients with OSA. However, there was a significant difference in 1-year mortality between the low-risk and high-risk for OSA groups (4.13 vs. 7.45%; $P<0.0001$) [24]. Mokhlesi *et al.* found that patients with OSA undergoing elective orthopedic, abdominal and cardiovascular surgeries had a decreased risk of in-hospital mortality. In contrast, patients with OSA undergoing revision total hip and knee arthroplasty was associated with increased risk of in-hospital mortality by two-fold [38]. Similarly, several studies reported increased mortality in patients with OSA undergoing cardiac surgeries [39,40]. This variation in the literature may be because of variation in the screening, diagnosing, monitoring practice, and treatment of OSA.

STOP-Bang AND DIFFICULT INTUBATION

Acar *et al.* conducted a prospective cohort study of 200 patients. The occurrence of difficult intubation (13.3 vs. 2.6%; $P=0.004$) was higher in patients at a high-risk of OSA (STOP-Bang $\geq$ 3) than the low risk [20]. In patients with high-risk OSA, the percentage of difficult intubation (20%, OR 1.86; 95% CI, 1.37–2.51) and difficult mask ventilation (23%, OR 2.06; 95% CI, 1.51–2.83) were higher compared to low-risk OSA [21]. Similar results were found in another prospective study of 127 obese patients undergoing bariatric surgery [41].

STOP-Bang AND SEDATION

STOP-Bang may help the anesthesiologists to identify patients likely to encounter sedation related complications allowing an appropriate sedation strategy. As it is often not possible to do a polysomnography prior to surgery, using the STOP-Bang questionnaire may lead to improved perioperative management of patients who may have unrecognized OSA during the sedation related procedures. The incidence of hypoxemia and airway maneuvers was significantly higher among patients with high-risk than low-risk OSA [21,26,42]. The episodes of desaturations associated with airway obstruction in the patients with high-risk OSA may disrupt the smooth management of these sedation related procedures.

CHALLENGES IN USE OF STOP-Bang

It is possible that patients with OSA with intermittent hypoxia may require less opioids. The interaction of OSA, sleep fragmentation, pain, and opioids requirement is an area that requires more research [43]. There is preliminary evidence that shows support for perioperative continuous positive airway pressure for patients with OSA [44▪▪,45▪▪]. STOP-Bang can help to risk-stratify patients for modified anesthesia technique and postoperative monitoring but there are challenges and limitation with the use of the tool. Although STOP-Bang has been validated in different populations, a selection bias might be present in some of the validation studies [14]. In studies targeting surgical patients, a self-selection bias from patients themselves may have existed in that those with pre-existing sleep symptoms might be more willing to consent to an overnight polysomnography [13]. The high prevalence of OSA in the study populations may affect the interpretation of the predictive parameters. Despite STOP-Bang being validated in multiple populations, it was less useful for identifying patients with OSA in the veteran population, and patients with renal failure [46,47]. Because measurement tapes may not be consistently available in the physician's office and there may be variability in measurement of the neck circumference, these challenges may affect the accuracy of the STOP-Bang score [14]. History of witnessed apneas or observed apneas may not be captured accurately if the patients are interviewed in the absence of their bed partners.

The inverse relationship between sensitivity and specificity at higher STOP-Bang diagnostic thresholds influences the relative rates of missed diagnoses and wasted resource utilization in diagnosing OSA [11▪▪]. The predictive values of the STOP-Bang questionnaire will be lower in many preoperative settings that have a lower prevalence of OSA [11▪▪]. To ensure effective screening, validation of the STOP-Bang questionnaire in the specific target population is recommended [14]. The optimal cut-off score of STOP-Bang should be determined in each specific population and a higher threshold can be adopted in the population with a lower prevalence of OSA. Despite these limitations, STOP-Bang adds clinical value to the preoperative assessment as it provides a relatively easy method of dichotomous risk stratification of high or low-risk of OSA [14,35▪▪].

CONCLUSION

STOP-Bang is the most convenient, validated, and effective screening tool in surgical patients because of its variety of practical applications during the perioperative period. The updated STOP-Bang questionnaire adds clinical value to the preoperative assessment as it provides a relatively easy method to risk stratify patients into high-risk or low-risk OSA. The probability of moderate-to-severe OSA increases proportionally to the STOP-Bang score. Patients with a score 0, 1 or 2 can be classified as low-risk for moderate-to-severe OSA. Those with a score of 5, 6, 7 or 8 can be classified as high-risk for moderate-to-severe OSA. In patients with a STOP-Bang score of 3 or 4, a second step using a combination of a STOP score at least 2 + BMI more than 35 kg/m^2 or STOP score at least 2 + male or STOP score at least 2 + neck circumference more than 40 cm indicates a higher risk of moderate-to-severe OSA. Further, patients with STOP-Bang score at least 3 can be classified as high-risk for moderate-to-severe OSA if the serum HCO_3^- at least 28 mmol/l. This step-wise approach is recommended for better stratification of OSA patients during the perioperative period.

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Conflicts of interest

Mahesh Nagappa, MD, has no conflicts of interest.
STOP-Bang is proprietary to University Health Network.
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David Wong, MD, has no conflicts of interest.

REFERENCES AND RECOMMENDED READING

Papers of particular interest, published within the annual period of review, have been highlighted as:
▪ of special interest
▪▪ of outstanding interest

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