Utility of the Berlin Questionnaire to Screen for Obstructive Sleep Apnea Among Patients Receiving Intravenous Sedation for Colonoscopy

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Obstructive sleep apnea (OSA) affects approximately 20% of Americans. Patients with undiagnosed OSA may experience obstructive episodes during conscious sedation for colonoscopy. The purpose of this investigation was to describe the risk of undiagnosed OSA using the Berlin Questionnaire and to identify the relationship between OSA risk and the number of provider interventions performed to relieve obstructive symptoms during sedation for colonoscopy. Methods: Adult patients were enrolled from the gastroenterology clinic at the National Military Medical Center (N=99). The Berlin Questionnaire was delivered and a brief health history obtained. Patients were observed for obstructive symptoms during sedation. Provider interventions were counted. 18 patients were monitored during their first night of sleep using a portable sleep monitor. Data were analyzed using the independent samples t-test, Chi-square, and Chi-square test for trend. Results: The incidence of undiagnosed OSA was 40.4%. Patients with hypertension had a higher rate of a positive screen for OSA (70%) than those without hypertension (20.3%), $\chi^2(1)=3.87$, $P<.05$. There was no statistical difference in the number of provider interventions between the 2 groups. Risk of undiagnosed OSA in this sample is large but it does not appear to be associated with episodes of obstructive symptoms requiring provider intervention.

Keywords: Berlin Questionnaire, colonoscopy, conscious sedation, obstructive sleep apnea, procedural sedation.

Obstructive sleep apnea (OSA) is a disorder that affects an estimated 20% of all Americans.[1] It has been linked to severe morbidity and mortality. Patients with OSA are at higher risk for occupational and motor vehicle accidents, cognitive impairment, cardiovascular disease, and stroke.[2-6] Despite the severe health concerns regarding OSA, it remains largely undiagnosed in the general population. Up to 85% of those with OSA have not been diagnosed with the disorder.[7]

Understanding the pathophysiology of OSA is crucial in order to identify the possible risk factors for a patient during sedation. OSA is a repetitive obstruction or closure of the upper airway, causing a partial or complete disturbance in breathing. In the patient with OSA, airway obstruction occurs because the negative inspiratory force during respiration exceeds the ability of the airway musculature to remain open. The patient's airway usually has a smaller, more collapsible lumen, which is a common result of morbid obesity.[8] Airway obstruction is exacerbated by the fact that OSA patients tend to be more sensitive to respiratory depressants.[9] Anesthetic agents and opioids, which inhibit respiration and decrease muscle tone in the upper airway, have a more profound effect on these patients and result in increased risk for a collapsed airway, requiring provider interventions to maintain oxygenation.[8,9]

Regardless of the etiology, OSA is characterized by periods of apnea or hypopnea that result from these obstructions. Apnea is defined as a ≥90% reduction in airway effort, and hypopnea is a ≥30% reduction in airway effort with a concurrent ≥4% decrease in oxygen saturation.[10] Both apnea and hypopnea must be >10 seconds in length to be clinically significant.[6] An apnea-hypopnea index (AHI) score is determined by dividing the total number of apnea-hypopnea incidents by the total hours of sleep.

Anesthesia providers and conscious sedation nurses should be aware of the risk factors for OSA. Classic signs and symptoms indicating a patient may be at risk for OSA include: obesity, snoring, witnessed apnea during sleep, apparent arousals during sleep, wake time somnolence, and fatigue, despite adequate sleep.[11] Physical character-

istics also play a role in identifying patients with OSA. Men are at a greater risk for OSA as they typically have increased body mass that surrounds the torso and neck. This risk further increases with age. Women suffer from OSA to a lesser degree than men, but pregnant women are at an increased risk. Smoking, alcohol consumption, and use of medications that cause sleepiness or relaxation may exacerbate the signs and symptoms of OSA.[12]

Patients that present to the gastroenterology (GI) clinic may screen positive for OSA without a formal diagnosis. OSA often goes unrecognized; only 10%–20% of patients are aware of their symptoms.[13] Research indicates that 16%–30% of patients undergoing routine endoscopy either have OSA or are at high risk for a positive screen.[14,15] Therefore, with over 10 million GI endoscopic procedures performed each year in the United States alone, there are likely a large number of people each year who undergo conscious sedation for endoscopy with undiagnosed OSA.

There are many reasons why OSA is underdiagnosed in the general population. The symptoms of OSA and its associated comorbidities are often overlooked in primary care practice.[16] If symptoms are recognized by the primary care provider, obtaining a definitive diagnosis is problematic. The gold standard for the diagnosis of OSA is in-laboratory polysomnography. However, sleep laboratories often have limited access, coupled with long waiting times. Wait times in the United States range from 2–10 months, and longer wait times exist for patients with public access or institutional healthcare.[17] In-lab polysomnography is cost prohibitive, typically exceeding $1,000 per study.[18] This further limits OSA diagnosis among the 15% of the population who lack health insurance. The difficulty involved in obtaining an OSA diagnosis has led to the development of questionnaires and technology, such as portable sleep monitors, all assisting healthcare providers in the recognition of OSA.

Portable sleep monitors (PSMs) provide a means of detecting and diagnosing OSA at a reduced cost, while offering greater convenience. Instead of staying overnight at a sleep laboratory, a PSM allows a patient to conduct the exam at home with an average cost of $130 per study.[18] Polysomnography has been shown to have no greater advantages in diagnosing and treating patients at high risk for OSA when compared to high-quality PSM exams.[19] In March 2008, the Center for Medicare and Medicaid Services determined that a continuous positive airway pressure (CPAP) machine is reimbursable when OSA is diagnosed with type III or IV portable sleep monitors, allowing for substantially greater means to diagnose OSA compared to traditional polysomnography.[20]

There are 3 paper-and-pencil instruments that are commonly used to screen for OSA: The Berlin Questionnaire (BQ), the STOP-BANG, and the ASA checklist. All are validated instruments that effectively identify patients at risk for OSA. One investigation compared the effectiveness of all 3 instruments, resulting in no significant difference in predictive parameters.[21] The most frequently used of all 3—the BQ—was found to have a sensitivity of 68.9%–87.2% and a specificity of 43%–87% when compared to polysomnography.[21]

Patients in the GI clinic can present unique challenges for the sedation provider. The incidence of undiagnosed OSA in this population remains poorly described. OSA may predispose these patients to respiratory or cardiovascular complications during sedation.[9,11] Patients with OSA may present with an airway that is difficult to access in an emergency situation.[22] Understanding how conscious sedation affects the number of provider interventions required to maintain airway patency and hemodynamic stability is critical to improving patient safety and controlling healthcare costs.

The purpose of this research was to describe the risk of undiagnosed OSA using the Berlin Questionnaire. In addition, we sought to identify the relationship between OSA risk and the number of provider interventions performed to relieve obstructive symptoms during sedation for colonoscopy. In a pilot portion, we set out to describe the relationship between OSA risk and the AHI, obtained from a PSM during the first night of sleep.

Materials and Methods

A descriptive, prospective investigation was carried out in the GI clinic at Walter Reed National Military Medical Center Bethesda (WRNMMCB). Power analysis yielded a target sample of 92 subjects, so a convenience sample of 102 subjects were enrolled in the study, allowing for 10% attrition. Effect size was based on previous research in a similar population using the BQ.[15] In addition, 22 subjects were selected to participate in the pilot portion of the study and were provided PSMs for overnight sleep monitoring. This pilot sample size was limited by funding and the number of sleep monitors available for use.

Patients scheduled for colonoscopy were approached upon their arrival to the GI clinic by the research team to determine eligibility and willingness to participate in the study. Inclusion criteria were any adult (≥18 years of age) scheduled to receive minimal or moderate sedation for a colonoscopy by trained conscious sedation nurses. Exclusion criteria were patients who were pregnant, patients with allergies or sensitivities to sedative medications, and those unable to provide a full informed consent. Additionally, since the study set out to describe undiagnosed OSA, those with a self-reported OSA diagnosis were also excluded. After meeting inclusion/exclusion criteria, subjects were given verbal and written informed consent and were enrolled in the study. Subjects were enrolled in the pilot portion of the study based only on sleep monitor availability. Only 10 monitors were available for use by the research team.

After enrollment, a brief health history was obtained and demographic data points were collected. Subjects were then instructed on how to complete the BQ and assistance was offered if needed. The procedural sedation was then observed by a second member of the research team that was blinded to the responses on the BQ. Intraprocedure data were collected. If the subject was enrolled in the pilot portion of the study, they were given a detailed demonstration of the PSM and its use. The subject was then sent home with the PSM for overnight wear during their first night of sleep following their colonoscopy. The monitor was returned via a postage prepaid box following its use.

• ***Berlin Questionnaire.*** In order to identify OSA risk, patients completed the BQ. The BQ is a screening tool used widely for the identification of patients who may be at high risk for OSA. The questionnaire consists of 11 questions separated into 3 categories (see Figure 1). Category 1 questions ask about episodes of snoring and cessation of breathing while sleeping. Category 2 questions discuss daytime sleepiness. Category 3 asks 1 question eliciting the incidence of high blood pressure. When 2 or more categories are classified as positive, the patient is deemed to be at high risk for OSA. Chung et al[21] examined the reliability of the BQ resulting in a Cohen coefficient test-retest of 96.3%.

• ***ASA Continuum of Depth of Sedation.*** During the procedural sedation, the ASA Continuum of Depth of Sedation[24] was used to assess and document the depth of sedation. Data collectors blinded to BQ results observed the effects of sedation for responsiveness to verbal and tactile stimulation, airway patency, spontaneous ventilation, and cardiovascular function. A score of 1–4 (minimum sedation, moderate sedation, deep sedation, general anesthesia, respectively) was assigned based on the assessed level of sedation at the beginning of the procedure, at 15-minute intervals, and again at the end of the procedure.

• ***Provider Interventions as Count Data.*** The effects of sedation were observed using 4 categories of provider interventions. The first category—airway manipulation—is routinely performed during conscious sedation procedures to prevent or relieve airway obstruction. Observation of specific airway manipulations included: (1) jaw lift; (2) realignment of the pharyngeal, oropharyngeal, and laryngeal axes (repositioning of the head); (3) placement of a nasopharyngeal or oropharyngeal airway; and (4) advanced airway interventions requiring an intubation or laryngeal mask airway (LMA™). These interventions are similar to those used in previous OSA screening studies for patients undergoing advanced endoscopic procedures.[25,26]

The second category included actions performed by the sedation provider in order to maintain hemodynamic stability. Specific actions included increasing fluid administration, repositioning the patient to increase cardiac perfusion, and physically stimulating the patient. Since colonoscopy frequently involves patient stimulation and repositioning for reasons that do not involve manipulation of hemodynamic stability, only the increase in fluid administration for hypotension was included in data analysis.

Category 1:

1) Do you snore?
2) How loud is your snoring?
3) How often do you snore?
4) Does your snoring ever bother other people?
5) Has anyone noticed that you quit breathing during your sleep?

Category 2:

1) How often do you feel tired or fatigued after your sleep?
2) During your waking time, do you feel tired, fatigued, or not up to par?
3) Have you ever nodded off or fallen asleep while driving a vehicle?
4) If you do fall asleep or nod off while driving, how often does this occur?

Category 3:

1) Do you have high blood pressure?

Figure 1. Components of the Berlin Questionnaire[21,23]
Note: Category 1 assesses snoring behavior, Category 2 assesses daytime somnolence and fatigue, and Category 3 identifies hypertension.

The third category included documenting the interventions performed to treat decreases in oxygen saturation. These were additional interventions that may have been performed to prevent hypoxic events in order to maintain adequate oxygenation to the tissues. Specific interventions to treat decreases in oxygen saturation included increasing oxygen flow rate, changing the airway delivery device, and the delivery of positive pressure mask ventilation.

The fourth category included the documentation of the use of the reversal agents (naloxone and flumazenil). These medications are rarely used during or after conscious sedation procedures. When these agents are administered, it is often in response to the patient that demonstrates a profound decreased level of consciousness after receiving a standard medication dose. This investigation documented the administration of agents used to reverse the effects of both opioids and benzodiazepines.

• ***Portable Sleep Monitors.*** In the pilot portion of the study, patients received an ApneaLink Plus™ portable sleep monitor (ResMed Corp., San Diego, CA). The ApneaLink Plus™ portable monitor is an FDA-approved, type III portable sleep breathing monitor (Figure 2). It uses a chest belt to record respiratory effort, a pressure sensitive nasal cannula to measure airflow, and pulse oximetry to measure oxygen saturation and heart rate. It is easy to use, simple to attach, and durable in the home environment. The device provides a graphic AHI score and

Figure 2. ApneaLink Plus™ Portable Sleep Monitor
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sleep-disordered breathing risk indicator. For patients with an AHI >5, the sensitivity and specificity of the device, when compared to polysomnography, is 85.4% and 50%, respectively. For those with an AHI >15, the sensitivity and specificity increase to 90.9% and 94.6%, respectively.[27] The first night of sleep after colonoscopy was monitored and recorded, and results were analyzed using software provided by the company. An AHI <5 indicated no disease, an AHI of 5–15 indicated mild OSA, an AHI of 15–30 indicated moderate OSA, and severe OSA was represented by an AHI score >30.[10]

• ***Data Analysis.*** The Statistical Package for the Social Sciences (SPSS version 17.0; IBM Corporation, Armonk, NY) was used to analyze the data. Descriptive and inferential statistics were used to analyze demographic data. *P* values <.05 were considered significant. The incidence of OSA as identified by the BQ was represented as a percent of the total sample. The mean number of airway interventions between those who screened positive and those who screened negative for OSA were analyzed using the independent samples *t*-test. If the data did not meet the criteria for the independent samples *t*-test, then a nonparametric analysis was used. In the pilot portion of the study, data were analyzed using Chi-square to compare postprocedure OSA severity between those who screened negative and those who screened positive for OSA. Independent samples t-test was used to compare mean AHI scores between the 2 groups. Chi-square test for trend was used to evaluate increases or decreases in AHI scores between the 2 groups.

Results

A total of 102 subjects were enrolled in the study. 3 subjects were excluded from the analysis because they violated inclusion criteria; they did not receive a colonoscopy. 64 were male and 35 were female. Of the 99 subjects included in the analysis, 40 screened high risk for OSA on the BQ. This represents an overall risk of 40.4%. The Mallampati classification of the sample was 83.8% for class I or II (normal airway), while 16.2% were class III or IV (potentially difficult airway). Those subjects that presented with a potentially difficult airway (MP III or IV) had a higher rate for a positive screen for OSA (62.5%) than those with a normal airway (MP I or II) (36.1%), $\chi^2(1)=3.87$, $P<.05$. Subjects with a history of hypertension represented 40.4% of the entire sample. Those that presented with a history of hypertension had a higher rate of a positive screen for OSA (70%) than those that did not have hypertension (20.3%), $\chi^2(1)=24.42$, $P<.05$. Subjects of African American descent had a higher rate of hypertension (59%) than those of all other races (33%), $\chi^2(1)=5.48$, $P<.05$. Demographic data are presented in Table 1.

Descriptive data (eg, means and standard deviations for continuous variables, frequencies and percentages for categorical variables) are displayed as appropriate in Table 2. No significant differences were noted between those with a positive BQ screen and those with a negative BQ screen when considering age, BMI, or coexisting disease. A significant association was found between those with a positive BQ screen and hypertension.

There was no significant difference in the number of provider interventions between groups. 3 subjects required increased oxygen flow, but no airway adjuncts were required. Jaw thrusts and head repositions were performed, but there was no significant difference between patients considered high or low risk for OSA based on the BQ. No subjects required a change in airway delivery device or use of reversal agents.

22 subjects were enrolled in the pilot portion of the study. Four subjects were excluded because the PSM did not register an adequate evaluation time for an accurate AHI. The mean AHI for all 18 subjects was 5.94 ± 6.56, range=0–19. The mean lowest oxygen desaturation was 86%, range 66%–94%. 8 subjects were considered high risk for OSA based on the BQ results (44.4%). Subjects that screened positive for OSA had a higher AHI during the first postprocedure night of sleep (M=9.0, se=2.58) than those who screened negative for OSA (M=3.5, se=1.57). Levene's test was not significant; therefore, homogeneity of variance was not violated. The difference was not significant ($t(16)= 1.90$, $P=.076$). Kappa (Spearman's correlation) was –0.41, $P=.066$.

Discussion

The incidence of patients at high risk for OSA in this sample was 40.4%. This reflects the findings of previous studies on the incidence of OSA among patients receiving

	Frequency	Percentage
Gender		
Male	64	64.6
Female	35	35.4
BMI		
Normal (≤29)	72	72.7
Obese (30–34)	21	21.2
Morbid (≥35)	6	6.1
ASA Class		
I	39	39.4
II	55	55.6
III	5	5.1
Race		
African descent	27	27.3
Asian	3	3.0
Caucasian	63	63.6
Hispanic	5	5.1
Other	1	1.0
Mallampati Score		
I and II	83	83.8
III and IV	16	16.2
Hypertension		
Positive history	40	40.4
Negative history	59	59.6

Table 1. Demographic Data
Abbreviation: BMI, body mass index.

sedation for colonoscopy.[15,25] Coté et al[25] found a 43.3% risk of OSA among patients presenting for endoscopy using the STOP-BANG screening tool. Khiani et al[15] found a 39% risk for OSA among endoscopy patients using the BQ. Our findings, limited to those who had no previous diagnosis of OSA, confirm that risk of undiagnosed sleep apnea remains highly prevalent in the endoscopy patient population.

Our findings also indicate that a high Mallampati score alone is associated with an increased risk for OSA. Previous research has yielded varied results. Mallampati score has been associated with a higher AHI, but the clinical relevance is under debate.[28,29] Mallampati classification is an inexpensive, objective assessment that can easily be taught to sedation providers and gastroenterology staff. The potential association between Mallampati score and OSA risk is intuitive, as OSA is associated with increased pharyngeal tissue and a loss of motor tone of the airway musculature.[8,9] Our findings suggest that further investigation may be warranted to determine if there is clinical value in presedation Mallampati screening by the nonanesthesia provider.

Among the subjects enrolled in the pilot portion of the study, mild OSA (AHI >5) was found in 7 subjects. 71% of these patients were identified as high risk for OSA via the BQ. Although the sample size was too small for statistical analysis, validation studies have confirmed the relationship between high-risk BQ scores and positive OSA diagnosis among the general population.[23,30] It should be noted that sedative agents and opioids impact sleep architecture in the OSA patient.[31,32] AHI scores and sleep patterns are altered during the first night of sleep after sedated procedures, as patients do not enter into phase III and IV deep sleep.[32] AHI scores rebound and increase

	Minimum	Maximum	Mean	Standard deviation
Age (years)	19	83	51.65	14.56
Height in inches	60	83	68.49	4.01
Weight in kilograms	46	134	83.95	16.32
Body mass index	18.0	48.0	27.62	4.87
Baseline systolic blood pressure	98	177	130.94	15.49
Baseline diastolic blood pressure	50	102	77.76	10.28
Baseline heart rate	47	130	70.86	14.94
Baseline respiratory rate	8	24	14.88	2.60
Baseline oxygen saturation (%)	94	100	98.80	1.39
Total time of sedation (minutes)	4	69	29.45	11.56
Number of jaw lifts	0	1	.02	.14
Number of head repositions	0	3	.15	.50
Adjustments in fluid administration	0	1	.02	.14
Increasing O_2 flow rate	0	1	.04	.20
Change in airway delivery device	0	0	.00	.000
Total amount of midazolam (mg)	1.5	7.0	3.67	1.04
Total amount of fentanyl (μg)	50	175	97.04	29.42
Total amount of meperidine (mg)	75	100	87.50	17.68

Table 2. Descriptive Data (N=99)

on postprocedure nights 2–4 as REM sleep returns.[31,33] Future studies with larger colonoscopy patient samples would benefit from baseline AHI scoring and multiple nights of postprocedure monitoring.

Despite the effectiveness of the PSM and screening questionnaires, there is little guidance on how to effectively provide sedation to a patient for endoscopy. The recommendations that exist for the anesthetic management of OSA patients are broad and encompass surgical patients as well as those undergoing sedation for outpatient procedures.[34,35] Standards for providing care to patients with known or suspected OSA in the endoscopy suite are poorly defined.[12] Depending on institutional policies, these patients may be managed by anesthesia personnel or by conscious sedation nurses.

The findings in this study have limitations. While the BQ is an effective screening tool, it is not specific for OSA severity. Other screening tools, such as the STOP-BANG, may be more effective at identifying patients at risk for severe OSA. Chung et al[36] found a STOP-BANG score of 5–8 is associated with a high probability of moderate-to-severe OSA. Future studies should consider using a screening tool such as the STOP-BANG that can identify OSA severity as well as risk. Additionally, our sample was limited to active duty military, military retirees, and military dependents who typically have better access to healthcare and therefore reflect an overall healthier population. Finally, the presence of preexisting hypertension is a large factor when scoring the BQ. Our findings that associate OSA risk with hypertension may be influenced by the nature of the screening tool itself.

Management of OSA patients for routine colonoscopy is controversial. Recommendations for anesthesia providers concerning the treatment of patients with OSA in the surgical setting have been published by the American Society of Anesthesiologists (ASA).[34,37] The use of capnography is highly recommended during procedures requiring sedation. More stringent postprocedure monitoring, including hospital admission, is often recommended. These ASA recommendations encompass all aspects of anesthetic care and are not specific to the outpatient endoscopy suite. ASA guidelines recognize that many aspects of periprocedure management of patients with OSA are insufficiently addressed in the literature. New consensus guidelines recommend that OSA patients should be considered for ambulatory surgery, provided that the procedure will not require opioid pain management and that comorbid disease states are well controlled.[35] Although stimulating, colonoscopy is not a painful ambulatory procedure. Research supports that patients who screen high risk for OSA show no difference in the risks of hypoxia during colonoscopy procedures when comparing them to patients who screened low-risk.[15,26] This suggests that the majority of patients at risk for OSA can be treated within standard sedation and practice guidelines.[15]

Although there was a large portion of this sample who screened high risk for undiagnosed OSA, there does not appear to be any association between OSA risk and increased complications, such as airway obstruction or hemodynamic instability. None of the subjects in this study achieved deep sedation according to the ASA Continuum of Depth of Sedation Scale. Subjects rarely required any intervention by the sedation provider and, when interventions were performed, the subjects responded immediately. This suggests that patients with OSA who receive moderate sedation for colonoscopy can be effectively and safely managed without the involvement of anesthesia staff.

Determining when an OSA patient requires anesthesia staff involvement can have a large economic impact. Anesthesia services provided to patients undergoing conscious sedation for endoscopy place a heavy burden on the healthcare system. The total number of patients receiving anesthesia care for endoscopy has doubled in recent years, from 14% in 2004 to 30% in 2009.[38] Associated costs for providing anesthetic services have tripled, to an estimated $1.3 billion. The majority of these services were provided to low-risk, ASA I or II patients, representing a total cost of $1.1 billion in 2009. In contrast, as of 2004, the average cost to provide sedation by nursing staff was $56.58, versus $419.52 for monitored anesthesia care.[39]

Based on previous studies on the effects of OSA during anesthesia, patients with known or suspected OSA are at increased risk for airway complications with deep sedation.[9,12] However, guidelines already exist on the immediate availability of advanced practitioners for airway management and cardiovascular support when deep sedation is likely or intended.[24] The Society of Gastroenterology Nurses and Associates (SGNA) recommends involving anesthesia providers whenever patients undergo procedures that require deep sedation.[40] Additionally, according to new consensus statements on management of OSA patients, comorbid conditions should be optimized prior to outpatient surgery and sedated procedures.[35] Therefore, it seems prudent to involve trained anesthesia providers for the delivery of sedation to optimized colonoscopy patients based on the depth of sedation required for the procedure—not based on known or suspected OSA alone. Further studies investigating severity of OSA and complications during mild sedation may help to further delineate when anesthesia providers are required for routine colonoscopy.

In conclusion, we found a 40% incidence of possible OSA in our sample. Our results suggest that colonoscopy patients with suspected OSA based on the BQ who undergo mild-to-moderate sedation do not appear to have increased risk of airway complications when compared to those patients at low risk for OSA. However, further research is needed to determine if patients who have possible undiagnosed moderate-to-severe OSA based on pre-

operative screening can safely receive mild-to-moderate sedation for colonoscopy. Additionally, future research should determine what effects mild-to-moderate sedation has on postoperative AHI values over a longer period of time (eg, 3–5 days). This line of research has important economic implications, and may save hundreds of millions of dollars in unnecessary costs associated with anesthesia resources.

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