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Sedation Challenges: Obesity and Sleep Apnea

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Obesity has become an epidemic health problem worldwide. Defined as a body mass index (BMI) of greater than or equal to 30 kg/m², obesity is divided into class I (BMI of 30–34.9 kg/m²), class II or severe obesity (BMI of 35–39.9 kg/m²), and class III or morbid obesity (BMI greater than 40 kg/m²). Some surgical literature further breaks down class III obesity into super obese which represents those with BMI of greater than or equal to 45 or 50 kg/m² [1–2]. In 2014, the World Health Organization (WHO) reported that 33% of adults aged 18 years and over were overweight (BMI > 25 kg/m²), and 13% were obese (BMI > 30 kg/m²) [1]. In the United States, this problem has become even more severe with over half of adults aged 20 years and over being overweight and 34.9% being obese as of 2012 [3]. To date, multiple conditions have been shown to be associated with obesity including hypertension, hyperlipidemia, diabetes, stroke, osteoarthritis and sleep apnea [4–5]. Additionally, multiple gastrointestinal diseases including gallbladder disease, esophageal cancer and colon cancer have also been demonstrated to be more prevalent in patients with a higher BMI [6–7]. As a result, all gastroenterologists will inevitably encounter an increase in the number of obese patients in their practice who are undergoing endoscopy.

Sedation is an integral component of every endoscopic examination. Defined as a drug-induced state in which the level of consciousness is depressed, sedation provides a relief in patients' discomfort and anxiety, and allows proceduralists to focus on the endoscopic work [8–9]. Four stages of sedation have been described: minimal, moderate, deep and general

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anesthesia (Table 1). Generally, most diagnostic and uncomplicated therapeutic upper endoscopy and colonoscopy can be successfully performed under moderate sedation, formerly known as “conscious sedation.” During moderate sedation, patients respond purposefully to verbal commands or tactile stimulation. For longer and more complex procedures, however, deeper levels of sedation may be required. These include deep sedation where patients cannot be easily aroused but may respond purposefully to painful or repeated stimulation and general anesthesia where patients are unarousable to painful stimuli. To appropriately choose the level of sedation for each procedure, multiple factors need to be taken into an account. These include patient’s age, comorbidities, concurrent medications, pain tolerance, and the type of endoscopic procedure being performed. In this article, we explore the medical literature on the effect of obesity and obstructive sleep apnea on endoscopic sedation.

Obesity and Sedation

Traditionally, a higher BMI has been thought to be associated with an increased risk during procedural sedation. This may be due to sleep apnea, pulmonary hypertension, and restrictive lung disease, which are more common in patients with obesity. Additionally, airway management in obese patients may prove to be more difficult due to rapid oxygen desaturation, challenges with mask ventilation and intubation, and increased susceptibility to the respiratory depressant effects of sedatives [10]. As a result, many institutions require an anesthesia consultation on all patients with a BMI of 40 and above prior to any endoscopic procedures in order to plan out the safest and most efficacious method of sedation.

Non-Bariatric Obese Population

While anecdotally obese patients are believed to be at higher risk for procedural sedation, this perception is not extensively backed up by the medical literature. In fact, the concept of BMI being a risk factor for sedation-related adverse events (SRAEs) has only recently gained an interest among gastroenterologists. In large national studies using the Clinical Outcomes Research Initiative National Endoscopic Database (CORI-NED) in 2004 and 2007, BMI was not included in the analyses as a potential risk factor for cardiopulmonary unplanned events during endoscopy [11–12]. In these studies, patient’s age, male gender, higher American Society of Anesthesiologists (ASA) classification grade, inpatient status, trainee participation and routine use of oxygen were associated with a higher incidence of cardiopulmonary unplanned events.

Available data on the use of sedation in obese patients remained quite sparse. Most were small case series and mainly evaluated the obese patients who were undergoing advanced endoscopic procedures or upper endoscopy prior to a bariatric surgery. Dhariwal and colleagues demonstrated in a case series of 82 patients undergoing diagnostic upper endoscopy that a BMI > 28 was a risk factor for hypoxemia [13]. In this study, other risk factors included age > 65 years and anemia with a hemoglobin < 10 g/dl. Similarly, Qadeer et al found that a higher BMI was an independent risk factor for hypoxemia in patients with ASA classes I and II. In this study, 79 patients undergoing outpatient upper endoscopy, colonoscopy, endoscopic retrograde cholangiopancreatography (ERCP) and endoscopic

ultrasonography (EUS) were included [14]. Other risk factors in this study were age 60 years and the total dose of narcotics. Subsequently, Berzin and colleagues conducted a study to assess risk factors of SRAEs during ERCP. The study included 528 patients undergoing ERCP under deep sedation and general anesthesia. Higher ASA class and BMI 30 were found to be associated with increased risk of cardiopulmonary unplanned events during ERCP [15]. Last but not least, to better understand the optimal method of sedation for patients with a higher BMI, Mahan et al performed a randomized trial of 100 morbidly obese patients (BMI 40) who underwent upper endoscopy before bariatric surgery. In this study, the patients were randomized to endoscopist-administered sedation with benzodiazepines and narcotics versus anesthesiologist-administered sedation with propofol. The study showed that significantly fewer patients in the anesthesiologist-administered sedation group remembered gagging during the procedure and/or complained of throat pain after the procedure. Therefore, it was concluded that deep sedation should be considered in patients undergoing preoperative upper endoscopy before bariatric surgery. Of note, in this study, hypoxemia and other cardiopulmonary unplanned events were not assessed, potentially because of the small sample size [16]. Therefore, no conclusions regarding procedural safety can be derived from this study. Of note, to date, there have been no studies that specifically assess the safety of performing endoscopy under moderate sedation in the super obese population.

Both anatomical and metabolic factors likely play a role in sedation challenges in the obese population. An altered airway anatomy found in obese patients has been shown to be associated with difficult endotracheal intubation. In 1985, Mallampati and colleagues developed and validated the Mallampati score to predict the ease of endotracheal intubation. The test consisted of a visual assessment of the distance from the tongue base to the roof of the mouth (Tables 2 and 3; Figures 1 and 2) [17–18]. A higher Mallampati score (class 3 or 4) has been shown to be associated with more difficult intubation. Subsequently, anesthesia literature has demonstrated an association between a higher Mallampati score, and a higher BMI to a higher risk of intubation [19–20]. However, to date, there have been no studies that specifically demonstrate that an advanced Mallampati score leads to increased risk of sedation during endoscopy. In addition to anatomical factors, obese patients appear to metabolize sedative agents differently compared to lean patients. Specifically, binding and elimination of drugs and volumes of distribution seem more unpredictable in obese patients. Higher BMI is also likely associated with higher adipose mass, a reduction in total body water, higher glomerular filtration rate (GFR) and normal hepatic clearance, which may lead to higher sedative dose requirement and thus increased sedation risks [21].

Given the sparse literature on a direct association between a higher BMI and increased SRAEs, most society guidelines on sedation in obesity are based on expert opinion. The American Society of Anesthesiologists Task Force on Sedation and Analgesia by Nonanesthesiologists mentioned that some pre-existing comorbidities may be related to adverse outcomes in patients receiving either moderate or deep sedation. These risk factors include significant obesity, especially if it involves the neck and facial structures [22–23]. Similarly, the American Gastroenterological Association (AGA) Institute review of endoscopic sedation recommended the use of an anesthesia professional for patients who are

morbidly obese (BMI ≥ 40) [13]. However, this is an expert opinion only and no supportive evidence was provided [24].

Bariatric Population

With the worsening obesity epidemic, the number of bariatric surgeries being performed has also increased. In 2013, about 179,000 bariatric surgeries were performed in the US. Of these, over one-third were Roux-en-Y gastric bypass (RYGB) [25]. While RYGB results in relatively durable weight loss and an improvement in pre-surgical comorbidities, postoperative complications including anastomotic leak, gastrogastic fistula, marginal ulceration and weight regain are not uncommon [26–27]. To manage these complications effectively, an endoscopic examination is usually required.

Anecdotally, bariatric patients have been observed to require higher sedative doses than those without a history of bariatric surgery which lead to increased sedation risks. Some institutions require an anesthesia professional during any endoscopic examination performed on RYGB patients, which usually leads to longer wait time and greater economic burden. Similar to non-bariatric obese patients, data on the use of sedation in the bariatric population remain very sparse. Jirapinyo et al reported that it was safe to perform upper endoscopy in the RYGB using moderate sedation, without anesthesia support. In this study, unplanned events were reported to be 1.6%, with 0.6% being cardiopulmonary unplanned events [28]. This was relatively similar to the reported SRAEs in the general population, which varied from 0.13% in Silvis et al to 0.9% in Sharma et al [29–30]. In this study, procedural length, and not absolute BMI, was the predictor of sedation requirement in the RYGB population. A subsequent matched cohort study from the same group showed that RYGB patients required higher doses of sedation during EGD than the non-RYGB with similar age, gender and BMI [31]. Authors hypothesized that these findings could be due to an improvement in liver function after gastric bypass, which resulted in an improvement in liver metabolism of fentanyl and midazolam, which subsequently led to increased requirement of both sedatives during EGD [32–33].

Based on the currently limited available data, performing uncomplicated upper endoscopy in the RYGB appears to be safe and effective under endoscopist-directed moderate sedation. However, more studies are needed regarding sedation choice for colonoscopy and other endoscopic procedures.

Obstructive Sleep Apnea and Sedation

Obstructive sleep apnea (OSA) is a sleep disorder that is defined as repetitive total or partial collapses of the upper airway causing episodes of apnea and hypopnea during sleep. It is found in about 4% of men and 2% of women [34]. While being overweight or obese is a strong risk factor, OSA may also occur in the non-obese population with the following risk factors: male, age higher than 40, neck size greater than 16 or 17 inches, enlarged tonsils, enlarged tongue, GERD, family history of sleep apnea and smoking [35]. The diagnosis of OSA requires clinical symptoms and the results of a formal sleep study (polysomnography). The Apnea Hypopnea Index (AHI) is an index used to indicate the severity of OSA. It is defined as the number of apneas or hypopneas recorded during the study per hour of sleep.

Mild OSA has 5 to 14.9 events per hour of sleep, moderate OSA falls in the range of 15 to 29.9 events per hour of sleep, and severe OSA has more than 30 events per hour of sleep.

It is thought that the presence of OSA may increase the risk of cardiopulmonary unplanned events during endoscopy. Anecdotally, some endoscopy units have required patients with known OSA bring their continuous positive airway ventilation (CPAP) for use during procedure recovery. However, similar to data on sedation in obesity, medical literature to support this concept remains somewhat conflicting. Khaini and colleagues studied the incidence of hypoxemia (pulse oximetry < 92%) in 233 subjects undergoing elective outpatient upper endoscopy and colonoscopy under moderate sedation using a combination of benzodiazepine and an opioid. In this study, the subjects were divided into high-risk (39%) and low-risk (61%) for OSA using the Berlin Questionnaire, which assessed snoring, daytime somnolence and hypertension and BMI (Table 4) in patients with no known formal diagnosis of OSA [36]. There was no significant difference in the incidence of hypoxemia between the high- and low-risk groups (odds ratio 1.48; 95% CI 0.58–3.80) [37]. The authors suggested that this finding might be due to the patient cohort being relatively healthy. As a result, in the setting of relatively brief procedures targeting moderate sedation, there appeared to be no added risk in subjects felt to be at risk for OSA. For patients requiring deeper sedation, however, data in the literature remains more varied. Cote et al assessed the sedation risk in 231 patients undergoing advanced procedures including EUS and ERCP under deep sedation or general anesthesia. The STOP-BANG questionnaire (SB) was used to screen patients with undiagnosed OSA in the pre-procedural setting (Table 5). It provides a quick, reproducible score from 8 yes or no questions (1 point each) that predicts patients with moderate to severe OSA. Of note, a prospective validation study demonstrated that a positive SB (score ≥ 3) has a sensitivity of 83.6% and 92.9% in predicting an AHI score of > 5 (mild sleep apnea) and an AHI of ≥ 15 (moderate to severe sleep apnea) [38]. Cote's study showed that patients with a positive SB score had a higher incidence of hypoxemia and the need for airway maneuvers such as a chin lift or placement of a nasopharyngeal airway [39]. In contradistinction, Mehta and colleagues reported that a higher STOP-BANG score was not associated with an increased incidence of sedation-related adverse events or with airway intervention in their study cohort of 243 patients undergoing upper endoscopy or colonoscopy under anesthesiologist-directed propofol sedation [40]. A higher BMI, however, was associated with an increased incidence of both outcomes.

Given the currently available data, the anesthesia guideline recommends that capnography or other automated devices should be used for monitoring of ventilation in patients with OSA who are undergoing procedures under moderate sedation [41–42]. Continuous positive airway ventilation (CPAP) monitoring may also be considered in this setting. Similarly, the American Society for Gastrointestinal Endoscopy guidelines suggest that a history of sleep apnea, snoring and stridor should be reviewed as part of the pre-endoscopic assessment since patients with OSA may be at increased risk for sedation-related complications during endoscopic examination [43].

Summary

Data on endoscopic sedation in patients with obesity and obstructive sleep apnea remain quite sparse. Most society guidelines on sedation in this patient population are based on expert opinions only. Most studies seem to suggest increased sedation requirement and risk of adverse events in patients with obesity and obstructive sleep apnea. However, to date, there has been no objective way to quantify this risk pre-endoscopically in order to designate the appropriate level of sedation and personnel prior to the procedure. In general, for most diagnostic and uncomplicated therapeutic upper endoscopy, data seems to demonstrate that it is safe and effective to perform the procedure under moderate sedation with a combination of benzodiazepine and opioids. For a longer and more complex procedure or for super obese patients, however, it seems prudent to arrange for anesthesia support. Until more population-based studies or randomized studies are available, performing endoscopy in this patient population should always alert providers to plan carefully and individualize sedation plans for every patient.

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Key Points

- Little evidence regarding endoscopic sedation in obesity and obstructive sleep apnea
- Moderate sedation is likely safe for diagnostic and simple therapeutic procedures in the general obese and bariatric populations
- Anesthesia support should be considered for more complicated therapeutic procedures and in the super obese

Figure 1a

Figure 1b

Figure 1.

Original Mallampati Score. 1A: Mallampati class 1. Faucial pillars, soft palate and uvula are visible. 1B: Mallampati class 3. Only soft palate is visible. Taken from Mallampati S, Gatt SP, Gugino LD, et al. A clinical sign to predict difficult tracheal intubation: a prospective study. *Can Aneasth Soc J* 1985;32:429–34.

Figure 2. Modified Mallampati score. Used with permission from Samssoon GL, Young JR. Difficult tracheal intubation. *Anaesthesia* 1987;42:487–90.

Table 1

Four stages of sedation

	Responsiveness	Airway	Spontaneous ventilation	Cardiovascular function
Minimal sedation	Normal response to verbal stimulation	Unaffected	Unaffected	Unaffected
Moderate sedation	Purposeful response to verbal or tactile stimulation	No intervention required	Adequate	Usually maintained
Deep sedation	Purposeful response after repeated or painful stimulation	Intervention may be required	May be inadequate	Usually maintained
General anesthesia	Unarousable even with painful stimuli	Intervention often required	Frequently inadequate	May be impaired

Modified from Gross JB, Bailey PL, Connis RT, et al. Practice guidelines for sedation and analgesia by nonanesthesiologists. *Anesthesiology* 2002;96:1004–17.

Table 2

Original Mallampati score

Class 1	Faucial pillars, soft palate and uvula could be visualized
Class 2	Faucial pillars and soft palate could be visualized, but uvula was masked by the base of the tongue
Class 3	Only soft palate could be visualized

Modified from Mallampati S, Gatt SP, Gugino LD, et al. A clinical sign to predict difficult tracheal intubation: a prospective study. Can Aneasth Soc J 1985;32:429–34.

Table 3

Modified Mallampati score

Class I	Soft palate, uvula, fauces, pillars visible
Class II	Soft palate, uvula, fauces visible
Class III	Soft palate, base of uvula visible
Class IV	Only hard palate visible

Modified from Samsoon GL, Young JR. Difficult tracheal intubation. *Anaesthesia* 1987;42:487–90.

Table 4

Berlin questionnaire. Modified from Netzer NC, Stoohs RA, Netzer CM, et al. Using the Berlin questionnaire to identify patients at risk for the sleep apnea syndrome. *Ann Intern Med.* 1999;131:485–491.

Category 1: Snoring	
1. Do you snore?	
a.	Yes
b.	No
c.	Don't know
2. Your snoring is:	
a.	Slightly louder than breathing
b.	As long as talking
c.	Louder than talking
3. How often do you snore?	
a.	Almost every day
b.	3–4 times per week
c.	1–2 times per week
d.	1–2 times per month
e.	Rarely or never
4. Has your snoring ever bothered other people?	
a.	Yes
b.	No
c.	Don't know
5. Has anyone noticed that you stop breathing during your sleep?	
a.	Almost every day
b.	3–4 times per week
c.	1–2 times per week
d.	1–2 times per month
e.	Rarely or never
<hr/>	
Category 2: Daytime somnolence	
6. How often do you feel tired or fatigued after you sleep?	
a.	Almost every day
b.	3–4 times per week
c.	1–2 times per week
d.	1–2 times per month
e.	Rarely or never
7. During your waking time, do you feel tired, fatigued or not up to par?	
a.	Almost every day
b.	3–4 times per week

c.	1–2 times per week
d.	1–2 times per month
e.	Rarely or never
8. Have you ever nodded off or fallen asleep while driving a vehicle?	
a.	Yes
b.	No
9. How often does this occur?	
a.	Almost every day
b.	3–4 times per week
c.	1–2 times per week
d.	1–2 times per month
e.	Rarely or never
<hr/>	
Category 3: Hypertension and BMI	
10. Do you have high blood pressure?	
a.	Yes
b.	No
c.	Don't know
BMI = ?	

Category 1: Item 1: if 'Yes', assign 1 point Item 2: if 'c' or 'd' is the response, assign 1 point Item 3: if 'a' or 'b' is the response, assign 1 point Item 4: if 'a' is the response, assign 1 point Item 5: if 'a' or 'b' is the response, assign 2 points Add points. Category 1 is positive if the total score is 2 or more points.

Category 2: items 6, 7, 8 (item 9 should be noted separately). Item 6: if 'a' or 'b' is the response, assign 1 point Item 7: if 'a' or 'b' is the response, assign 1 point Item 8: if 'a' is the response, assign 1 point Add points. Category 2 is positive if the total score is 2 or more points.

Category 3 is positive if the answer to item 10 is 'Yes' or if the BMI of the patient is greater than 30 kg/m².

High Risk: if there are 2 or more categories where the score is positive.

Low Risk: if there is only 1 or no categories where the score is positive.

Table 5

STOP-BANG questionnaire. High risk of OSA: yes to 3 questions; low risk of OSA: yes to < 3 questions. Modified from Chung F, Yegneswaran B, Liao P, et al. STOP questionnaire: a tool to screen patients for obstructive sleep apnea. *Anesthesiology*. 2008;108:812–21.

S	Snoring: Do you snore loudly (louder than talking or loud enough to be heard through closed doors)?	Yes	No
T	Tired: Do you often feel tired, fatigued, or sleepy during the daytime?	Yes	No
O	Observed: Has anyone observed you stop breathing during your sleep?	Yes	No
P	Blood pressure: Do you have or are you being treated for high blood pressure?	Yes	No
B	BMI: BMI more than 35 kg/m ²	Yes	No
A	Age: Age over 50 years	Yes	No
N	Neck circumference: Neck circumference greater than 40 cm	Yes	No
G	Gender: Male	Yes	No