Communication from the ASGE Standards of Practice Committee

GUIDELINE

Guidelines for sedation and anesthesia in GI endoscopy

Prepared by: ASGE STANDARDS OF PRACTICE COMMITTEE

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The ASGE guidelines for sedation and anesthesia in GI endoscopy were reviewed and endorsed by the American Association for the Study of Liver Diseases, the American College of Gastroenterology, and the American Gastroenterological Association.

This document was reviewed and approved by the Governing Board of the American Society for Gastrointestinal Endoscopy.

This document is an update of guidelines for sedation and anesthesia in endoscopy prepared by the Standards of Practice Committee of the American Society for Gastrointestinal Endoscopy (ASGE). In preparing this guideline, a search of the medical literature was performed by using PubMed from January 1980 through August 2017 that related to the topic of "sedation and anesthesia for gastrointestinal endoscopy" by using the keyword(s) "sedation," "anesthesia," "gastrointestinal endoscopy," "endoscopy," "endoscopic procedures," and "procedures." The search was supplemented by accessing the "related articles" feature of PubMed, with articles identified on PubMed as the references. Pertinent studies published in English were reviewed. Additional references were obtained from the bibliographies of the identified articles and from recommendations of expert consultants. When little or no data existed from well-designed prospective trials, emphasis was given to results from large series and reports from recognized experts. Guidelines for appropriate use of endoscopy are based on a critical review of the available data and expert consensus at the time the guidelines were drafted. Further controlled clinical studies may be needed to clarify aspects of this guideline. This guideline may be revised as necessary to account for changes in technology, new data, or other aspects of clinical practice. The recommendations were based on reviewed studies and were graded on the strength of the supporting evidence by using the GRADE criteria (Table 1).[1]

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This guideline is intended to be an educational device to provide information that may assist endoscopists in providing care to patients. This guideline is not a rule and should not be construed as establishing a legal standard of care or as encouraging, advocating, requiring, or discouraging any particular treatment. Clinical decisions in any particular case involve a complex analysis of the patient's condition and available courses of action. Therefore, clinical considerations may lead an endoscopist to take a course of action that varies from these guidelines.

Sedation is a drug-induced depression in the level of consciousness. The clinical objectives of administering sedation for GI endoscopy are to relieve patient anxiety and discomfort, improve the outcome of the examination, and diminish the patient's memory of the event. A number of different sedatives and analgesics can be used to achieve appropriate levels of sedation for GI endoscopic procedures. The targeted level of sedation may vary depending on patient and procedural variables, and doses of sedatives should be titrated accordingly to achieve a safe, comfortable, and technically successful endoscopic procedure. Knowledge of the pharmacologic profiles of sedation agents is necessary to maximize the likelihood that the desired level of sedation is achieved.

Practice guidelines for non-anesthesiologists providing sedation have been put forth by the American Society of Anesthesiologists (ASA) Committee for Sedation and Analgesia by Non-Anesthesiologists and were approved by the ASGE.[2-4] A sedation continuum has been described, ranging from minimal sedation or anxiolysis to general anesthesia (Table 2). During endoscopic procedures

TABLE 1. System for rating the quality of evidence for guidelines[1]

Quality of evidence	Definition	Symbol
High quality	Further research is very unlikely to change our confidence in the estimate of effect.	⊕⊕⊕⊕
Moderate quality	Further research is likely to have an important impact on our confidence in the estimate of effect and may change the estimate.	⊕⊕⊕○
Low quality	Further research is very likely to have an important impact on our confidence in the estimate of effect and is likely to change the estimate.	⊕⊕○○
Very-low quality	Any estimate of effect is very uncertain.	⊕○○○

Adapted from Guyatt et al.[1]

TABLE 2. Levels of sedation and anesthesia

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

performed with moderate sedation (formerly referred to as *conscious sedation*), the patient maintains ventilatory and cardiovascular function and is able to make purposeful responses to verbal or light tactile stimulation.[2,5] In contrast, a patient undergoing deep sedation cannot be aroused easily but may respond purposefully to repeated or painful stimulation. Airway support maneuvers, such as performance of chin lifts or jaw thrusts as well as insertion of oral or nasal airways, may be required during deep sedation. At the level of general anesthesia, the patient cannot be aroused by painful stimuli, and cardiovascular function may be impaired. Individuals differ in their responses to sedation and may require different levels of sedation for the same procedure. In addition, patients may attain varying levels of sedation during a single procedure. Therefore, practitioners should possess the skills necessary to resuscitate or rescue a patient whose level of sedation is deeper than initially intended.[5]

This article evaluates the strength of evidence in the medical literature to provide guidelines for the use of sedation and anesthesia across all levels of sedation during GI endoscopic procedures and is an update of 3 previous ASGE documents.[3,6,7]

Providers of GI endoscopy should be trained specifically to provide procedural sedation across the sedation continuum, from minimal through moderate sedation. This training should include skills in recognizing when the level of sedation is deeper than planned as well as in the ability to rescue patients when this occurs. The multi-society sedation curriculum for GI endoscopy should serve as a guide to train providers in procedural sedation.[5]

PRE-PROCEDURAL PREPARATION AND ASSESSMENT

Patients should provide informed consent for administration of sedation through a process that involves a discussion of benefits, risks, and limitations as well as possible alternatives to the sedation plan.[8] As much as possible, the level of sedation targeted should be commensurate with the patient's expectation of sedation depth as well as that necessary to perform the procedure safely and effectively.

Because of risks of aspiration with blunting of airway-protective reflexes, patients undergoing sedation should be asked to fast for a specific time period. There are no data to support a direct relationship between duration of fasting and the risk of pulmonary aspiration, and the literature contains varying recommendations for oral intake before procedural sedation.[9] There is no practice standard for pre-procedural fasting that has been universally accepted. The ASA guidelines indicate that patients should not drink fluids or eat solid foods for a sufficient period of time to allow for gastric emptying before the procedure.[10] Specifically, these guidelines state that patients should fast a minimum of 2 hours after ingestion of clear liquids and 6 hours after ingestion of light meals before sedation is administered. In situations where gastric emptying is impaired or in emergent situations, the potential for pulmonary aspiration of gastric contents must be considered in determining (1) the target level of sedation, (2) whether the procedure should be delayed, or (3) whether the airway should be protected by

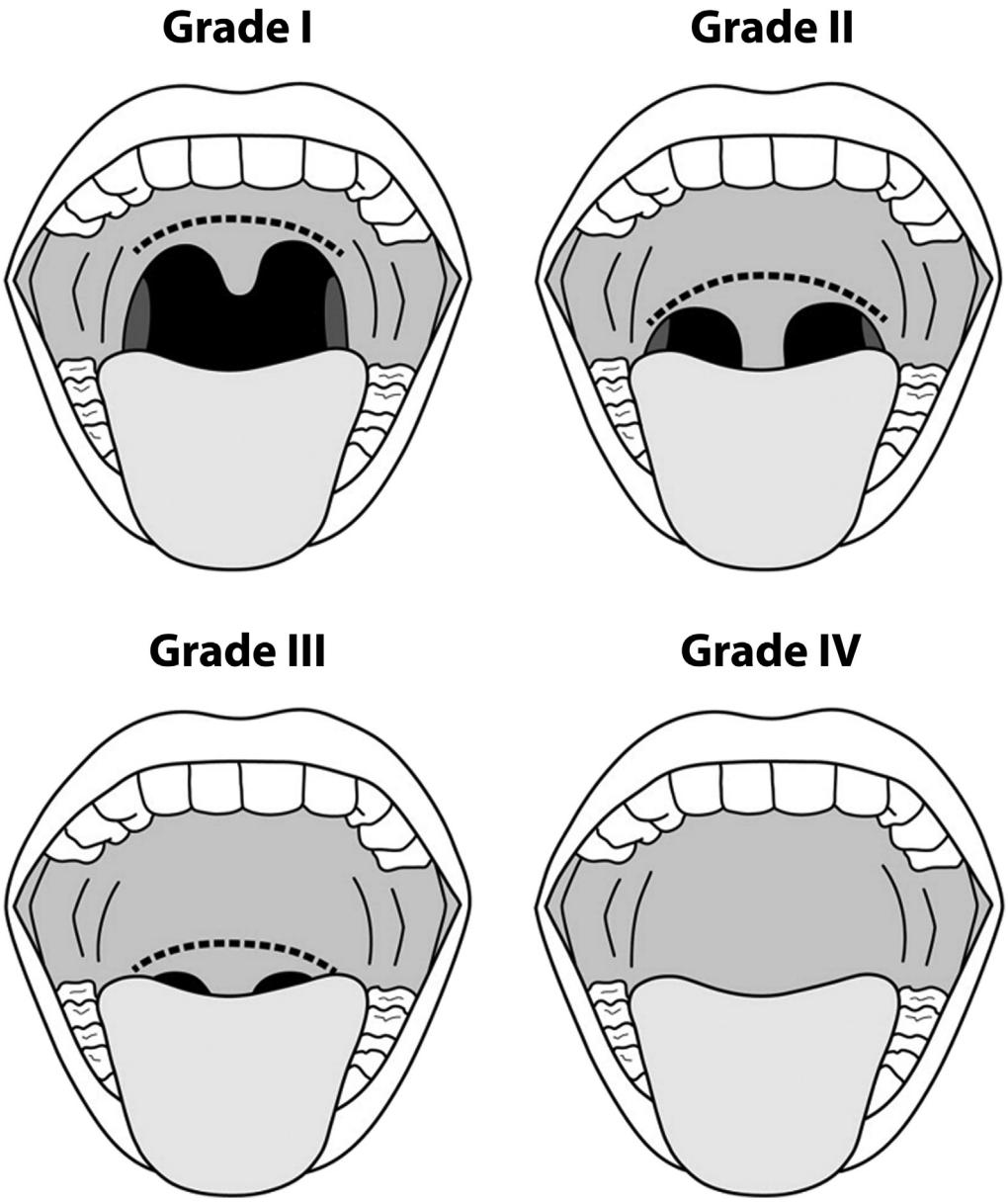

Figure 1. The Mallampati Classification. Class I: soft palate, fauces, uvula, pillars. Class II: soft palate, fauces, portion of uvula. Class III: soft palate, base of uvula. Class IV: hard palate only. The original figure was first published in the article "Multisociety sedation curriculum for gastrointestinal endoscopy" Gastrointest Endosc 2012;76:el-25 and is reused with permission.

endotracheal intubation.[11] In these instances, a team approach to minimize the patient's aspiration risk should be used.

All patients undergoing endoscopic procedures require pre-procedural evaluation to assess their risk for sedation and to manage potential problems related to pre-existing medical conditions. A history and focused physical examination at the time of the procedure are necessary. Elements of the history that may impact sedation include (1) a history of snoring, stridor, or sleep apnea; (2) a history of drug allergies, use of current medications, and potential for drug interactions; (3) a history of an adverse reaction to sedation or anesthesia; (4) time and contents of the last oral intake; and (5) a history of tobacco, alcohol, or substance use.[12] A focused physical examination includes vital sign measurements, auscultation of the heart and lungs, and assessment of the patient's baseline level of consciousness and airway anatomy (Fig. 1).[5] In addition, pregnancy testing should be obtained from all women of childbearing age in the appropriate clinical setting, because some sedatives may be teratogenic.[13,14] Table 3 shows the ASA classification used to risk-stratify patients for sedation.[15] One recent retrospective study of more than 1 million patients undergoing endoscopy and colonoscopy confirmed that the ASA class is associated with a risk of adverse events during GI procedures and

TABLE 3. ASA classification

Class	Description
I	The patient is normal and healthy.
II	The patient has mild systemic disease that does not limit activities (eg, controlled hypertension or controlled diabetes without systemic sequelae).
III	The patient has moderate or severe systemic disease that does not limit activities (eg, stable angina or diabetes with systemic sequelae).
IV	The patient has severe systemic disease that is a constant threat to life (eg, severe congestive heart failure, end stage renal failure).
V	The patient is morbid and is at a substantial risk of death within 24 hours (with or without a procedure).
E	Emergency status: in addition to indicating the underlying ASA status (I-V), any patient undergoing an emergency procedure is indicated by suffix "E."

ASA, American Society of Anesthesiologists.

may be useful in stratification of risk for GI endoscopy.[16] Analysis of the Clinical Outcomes Research Initiative database has demonstrated that increasing ASA class is associated with increased risk of unplanned cardiopulmonary events during endoscopy.[16,17]

Documentation and sedation planning in accordance with the ASA and the ASGE recommendations are important quality metrics.[5] In addition, regulatory frameworks, including those of the Joint Commission, mandate that pre-procedural assessment should be documented and a procedural pause ("time out") should be performed before initiation of sedation.[18] During the time out, the patient and all members of the procedure team stop other activities to perform a final verification of patient identification and the planned outcome, including the sedation plan, before the procedure is begun.[19]

The Mallampati Classification identifies potential obstructive sleep apnea and predicts difficulty with any endotracheal intubation.[20] This classification is based on the structures visualized with maximal mouth opening and tongue protrusion in the sitting position (Fig. 1). In addition, airway management may be difficult in patients with the following situations: (1) previous problems with anesthesia or sedation; (2) a history of stridor, snoring, or sleep apnea; (3) dysmorphic facial features, such as Pierre-Robin syndrome or trisomy 21; (4) oral abnormalities, such as a small opening (<3 cm in an adult), edentulous dentition, protruding incisors, loose or capped teeth, high arched palate, macroglossia, tonsillar hypertrophy, or a nonvisible uvula; (5) neck abnormalities, such as obesity involving the neck and facial structures, short neck, limited neck extension, decreased hyoid-mental distance (<3 cm in an adult), a neck mass, cervical spine disease or trauma, tracheal deviation, or advanced rheumatoid arthritis; and (6) jaw abnormalities such as micrognathia, retrognathia, trismus, or significant malocclusion.[5]

An ASA task force that devised guidelines for sedation and analgesia administered by non-anesthesiologists states that the presence of 1 or more sedation-related risk factors coupled with the potential for deep sedation will increase the likelihood of sedation-related adverse events.[2] According to the ASA, if the practitioner confronted with these situations is not trained in the rescue of patients from general anesthesia, an anesthesia professional should be consulted to provide sedation (Table 4).

TABLE 4. Guideline for anesthesia provider assistance during GI endoscopy

Anesthesia provider assistance should be considered in the following situations:
Prolonged or therapeutic endoscopic procedures requiring deep sedation
Anticipated intolerance to standard sedatives
Increased risk for adverse event because of severe comorbidity (ASA class IV or V)
Increased risk for airway obstruction because of anatomic variant

ASA, American Society of Anesthesiologists.

INTRA-PROCEDURAL PATIENT MONITORING

Recommendations for various staff roles and responsibilities for patient monitoring as well as minimum staffing numbers during sedated procedures, were addressed in a recent ASGE guideline on safety in the endoscopy unit.[20] Patient monitoring during sedated GI endoscopy may detect changes in pulse, blood pressure, ventilatory status, cardiac electrical activity, and level of sedation before clinically significant events occur. For both moderate and deep sedation, patient level of consciousness and vital signs must be periodically assessed and documented at a frequency that depends on the type and amount of medication administered, the length of the procedure, and the general condition of the patient. At a minimum, the assessment of the patient's level of consciousness and vital signs should be done (1) before the procedure is begun; (2) after administration of sedative-analgesic agents; (3) at least every 5 minutes during the procedure; (4) during initial recovery; and (5) just before discharge. If recording is performed automatically, device alarms should be set to alert the care team to critical changes in patient status. Equipment and medications for emergent resuscitation should be immediately available. For moderate sedation,

the personnel assigned to monitoring the patient can be assigned brief and interruptible tasks (such as mucosal biopsy), provided that the patient has not reached a state of deep sedation. For deep sedation, personnel assigned to monitoring the patient must do so in a continuous and uninterrupted fashion.[2,5]

Minimal patient monitoring requirements for sedated GI procedures include electronic assessment of blood pressure, heart rate, and pulse oximetry and the visual assessment of ventilatory activity, level of consciousness, and discomfort.[20] ASA guidelines recommend continuous electrocardiogram (ECG) monitoring of patients with significant cardiovascular disease or dysrhythmia during moderate sedation.[2] Other patients who may benefit from ECG monitoring include those with a history of significant pulmonary disease, the elderly, and those in whom prolonged procedures are anticipated. All patients receiving intravenous sedation should be monitored with non-invasive blood pressure devices.

Pulse oximetry effectively detects oxygen desaturation in patients undergoing sedation and analgesia, and both the ASA and the ASGE recommend that pulse oximetry be used during all sedated endoscopic procedures.[2,6] Risk factors for hypoxemia include a baseline oxygen saturation of less than 95%, emergent indication for the endoscopic procedure, a procedure of long duration, difficulty with esophageal intubation, and the presence of comorbid illness. The routine administration of supplemental oxygen has been shown to reduce the magnitude of oxygen desaturation during sedated endoscopic procedures.[21] The ASA and the ASGE recommend that supplemental oxygen be considered for moderate sedation, and it is required for all procedures with intended deep sedation. Supplemental oxygen should be administered if hypoxemia is anticipated or develops.[2,5]

Capnography is a noninvasive technology that detects disordered or depressed respiratory activity by graphic assessment of the partial pressure of carbon dioxide throughout the respiratory cycle.[22] Capnography has been demonstrated to detect depressed respiratory activity before transient hypoxemia,[23,24] but a clear link between transient hypoxemia and serious cardiopulmonary unplanned events during sedated endoscopy has not been established.[25] Integrating capnography into patient monitoring protocols for endoscopic procedures with moderate sedation has not been shown to improve patient safety; however, there is evidence supporting its use in procedures targeting deep sedation. A randomized study of more than 500 patients undergoing colonoscopy with deep sedation found a significantly lower incidence of transient hypoxemia in patients with capnography monitoring compared with those receiving standard monitoring.[26] Independent risk factors for hypoxemia in this study were age, high body mass index, history of sleep apnea, and increased doses of sedatives. A recent randomized controlled trial in healthy ASA Class I and II patients undergoing elective outpatient upper endoscopy and colonoscopy targeting moderate sedation with a combination of benzodiazepines and opioids found that capnography did not reduce the incidence of hypoxemia in either procedure type.[27]

After the completion of endoscopic procedures, patients should be monitored for adverse effects from either instrumentation or sedation. Standardized discharge criteria should be used to assess recovery from sedation. Post-procedural monitoring after sedated endoscopy has been discussed in a previously published ASGE guideline.[20]

UNSEDATED ENDOSCOPY

Select patients may be able to undergo endoscopic procedures without sedation,[28,29] and provider education may increase patient willingness to consider this option.[30] Small-diameter endoscopes (<6 mm) can improve the tolerability of upper endoscopy when sedation is not used.[31] In general, topical anesthesia is used during unsedated upper endoscopy. Successful colonoscopy also is possible in selected patients who receive no sedation or sedation only if needed.[32,33] Older patients, men, patients who are not anxious, and patients without a history of abdominal pain may be more willing to undergo upper endoscopy or colonoscopy with little or no sedation.[34-36] Standard pre-procedural preparation for sedation and monitoring, including intravenous insertion, should be followed, in the event that the patient does not tolerate the procedure or develops a cardiopulmonary unplanned event, and sedation is ultimately required. In addition, the use of water-assisted or carbon dioxide insufflation may reduce pain during and after the procedure in both unsedated and sedated colonoscopy.[37,38] The use of topical anesthesia may decrease patient discomfort in those receiving unsedated procedures or non-propofol mediated sedation. In randomized controlled trials that used propofol mediated sedation for EGD, topical anesthesia did not affect endoscopist satisfaction, the total propofol dose, or patient responsiveness.[39-41]

MINIMAL AND MODERATE SEDATION FOR ENDOSCOPY

Minimal and moderate sedation are defined in Table 2 and are routinely used to improve patient tolerance of upper endoscopy and colonoscopy. Endoscopy is generally well tolerated but may be associated with pain or discomfort during the procedure as well as anxiety about the procedure and possible findings. The decision to use minimal or moderate sedation should be shared between the provider and patient. There is an expectation in the United States that endoscopic procedures will be performed by using at least minimal

sedation, although patient wishes and medical conditions must be considered when determining whether sedation is necessary and safe.

Minimal and/or moderate sedation can be delivered safely by endoscopists to patients who are ASA Class I, II, or III. Other candidates for minimal or moderate sedation include those with a history of previously successful procedures with moderate sedation and an expectation for moderate sedation as well as those undergoing a procedure that is expected to be uncomplicated or routine.[42]

Medications targeting minimal and moderate sedation generally can be administered in an incremental fashion by an appropriately trained registered nurse (RN) under the supervision of an endoscopist. Patient response to administered sedatives and analgesics should be monitored by a nurse (generally an RN), whose primary responsibility is patient monitoring.[5,6,22] In this setting, the RN can perform short, interruptible tasks in addition to monitoring the patient.

Moderate sedation with benzodiazepines and opioids

Minimal and moderate sedation regimens typically consist of a benzodiazepine to minimize anxiety and a narcotic analgesic to minimize pain and discomfort. Benzodiazepines have been used either alone or in combination with an opiate to achieve minimal to moderate sedation for endoscopy. The most commonly used benzodiazepines are midazolam and diazepam. The efficacy of sedation with these 2 benzodiazepines is comparable.[42] However, most endoscopists favor midazolam for its fast onset of action, short duration of action, lower risk of thrombophlebitis, and high amnestic properties.[5,43]

Opiates, such as meperidine and fentanyl administered intravenously, provide both analgesia and sedation. Fentanyl has a more rapid onset of action and clearance and has a lower incidence of nausea compared with meperidine. The pharmacologic profiles of the benzodiazepines and opiates are discussed in a previously published ASGE document.[5] Specific antagonists of opiates (naloxone) and benzodiazepines (flumazenil) should be readily available in every endoscopy unit. The effects of reversal agents may be shorter than the effects of the benzodiazepines and opioids themselves. Therefore, a policy of extended recovery room monitoring may be necessary to avoid post-discharge sedation-related issues.[5]

Pharmacologic adjuncts to a typical benzodiazepine-narcotic combination may include diphenhydramine, promethazine, and droperidol. These medications potentiate the action of the benzodiazepine-narcotic regimen and can result in deeper levels of sedation and potentially a prolonged recovery. Droperidol is a neuroleptic agent in the same class as haloperidol and has sedative effects. Randomized trials have demonstrated the efficacy of droperidol in patients undergoing therapeutic endoscopy, particularly those who are difficult to sedate.[44,45] A black box warning on the U.S. Food and Drug Administration product label indicates that droperidol should be used only when first-line agents have not provided adequate sedation.[46] Droperidol use is contraindicated in patients with a prolonged QTc interval (>440 ms in men, >450 ms in women), and should be used with extreme caution in patients at increased risk of developing QT interval prolongation (eg, patients receiving other medications known to increase the QT interval; patients with a history of congestive heart failure, bradycardia, diuretic use, cardiac hypertrophy, alcohol abuse, hypokalemia, hypomagnesemia; aged >65 years) because of the risk of ventricular tachyarrhthmias.[47,48] In addition, the use of diphenhydramine has been shown to improve sedation and decrease pain in patients undergoing colonoscopy with a combination of an opioid and benzodiazepine.[49]

Balanced propofol for moderate sedation

The use of propofol in addition to an opioid and benzodiazepine is referred to as balanced propofol sedation (BPS). BPS can be effective in achieving moderate sedation for endoscopic procedures.[4,50] BPS will be discussed further in the section on propofol-mediated sedation.

PROPOFOL-MEDIATED SEDATION

Non-anesthesiologist–administered propofol sedation

Extensive data have demonstrated the safety and efficacy of non-anesthesiologist–administered propofol sedation (NAAP). NAAP can be divided further into nurse-administered propofol sedation (NAPS), in which propofol is administered as a single agent to target deep sedation under the direction of the endoscopist, and BPS, which involves the administration of a single dose of an opioid and benzodiazepine followed by intermittent bolus administration with propofol to target moderate sedation. NAAP has been associated universally with shorter sedation times and shorter recovery times, when compared with the combination of an opioid and benzodiazepine targeting moderate sedation thus supporting its use in routine sedation regimens.[50] NAAP requires specialized training, patient selection, and personnel dedicated to continuous physiologic monitoring (Table 4). Regulations regarding administration of propofol are determined at the state, regional, and local levels regardless of the targeted level of sedation. As a result, the practice of NAAP is quite limited nationally. Hence, propofol-based sedation for low-risk patients undergoing routine procedures often is administered by anesthesia personnel.

Published protocols for NAPS[51-53] report various dosing schedules of administered propofol. Propofol dosing and the depth of sedation should be individualized to the needs of each patient.[7]

TABLE 5. Recommendations for propofol use during endoscopy

A sedation team with appropriate education and training. At least 1 person who is qualified in advanced life support skills (ie, airway management, defibrillation, and the use of resuscitative medications).
Trained personnel dedicated to the uninterrupted monitoring of the patient's clinical and physiologic parameters throughout the procedure should be available.
Physiologic monitoring must include pulse oximetry, electrocardiography, and intermittent blood pressure measurement. Monitoring oxygenation by pulse oximetry is not a substitute for monitoring ventilatory function. Capnography should be considered because it may decrease the risks during deep sedation. Continuous monitoring will allow recognition of patients who have progressed to a deeper level of sedation.
Personnel should have the ability to rescue a patient who becomes unresponsive or unable to protect his or her airway or who loses spontaneous respiratory or cardiovascular function.
Age-appropriate equipment for airway management and resuscitation must be immediately available.
A physician should be present throughout propofol sedation and must remain immediately available until the patient meets discharge criteria.

NAPS should be administered by personnel specifically trained in its administration who should have expertise in emergency airway management and must be present continuously during its use.[5] In addition, the patient's physiologic parameters and level of sedation must be continuously monitored. Multiple studies have shown a high level of safety and have confirmed that it compares favorably with lighter levels of sedation by using a combination of an opioid and benzodiazepine. The appropriate personnel and equipment for deep sedation propofol administration are listed in Table 5.

In centers in the United States and worldwide where it is permitted, NAPS is typically performed by trained RNs whose sole responsibilities are patient monitoring and administration of propofol.[54] In a multicenter retrospective review of more than 36,000 endoscopies performed with NAPS, the rate of clinically important events, defined as an episode of apnea or other airway compromise requiring assisted ventilation, was <0.2%.[55] Endotracheal intubation was not required, and no patient had permanent injury or died.

A prospective study of more than 24,000 patients receiving NAPS found a major adverse event rate of 0.016%, involving 2 patients who received bag-mask ventilation and 1 who experienced largyngospasm.[56] The minor adverse event rate in this same series, which included patients who received monopropofol infusions or propofol plus midazolam, was 0.46% and was mostly characterized by transient and reversible hypoxemia. Several studies have compared NAAP sedation to standard moderate sedation (ie, a benzodiazepine plus narcotic), with respect to safety, patient and provider satisfaction, and induction and recovery times. Two randomized controlled trials compared NAPS for colonoscopy with a combination regimen of midazolam and fentanyl[57] and midazolam plus meperidine.[58] All studies found that NAPS exhibited significantly shorter recovery times. There were no significant differences across sedation regimens in the incidence of bradycardia, hypotension, hypoxemia, physician satisfaction, or in the number of patients reporting pain or discomfort. Patient satisfaction across all controlled trials was lower with midazolam plus narcotic, when compared with monopropofol sedation.

BPS is effective at achieving moderate sedation for endoscopic procedures.[4,50] BPS provides the benefits of propofol-mediated sedation, such as shorter recovery times and enhanced patient satisfaction, while reducing the risk of over-sedation.[50,59-61] Typically, loading doses of an opioid and benzodiazepine are given, followed by intermittent bolus dosing of propofol to target moderate sedation. When propofol is used alone for endoscopy, its lack of analgesic properties may require larger doses and therefore result in deep sedation,[55] for which there is no specific reversal agent.[62] In contrast, when BPS is used, analgesia and amnesia can be achieved with less than hypnotic doses, mitigating the potential for deep sedation. Furthermore, more precise dose titration is possible with smaller bolus doses of propofol (5-15 mg), and the potential for partial pharmacologic reversibility is retained by using naloxone or flumazenil.[5,50,51,63]

Anesthesia provider–administered sedation

Anesthesia provider–administered sedation comprises a sizeable proportion of procedural sedation for outpatient endoscopic procedures in the United States. It is estimated that over half of colonoscopies currently are performed with monitored anesthesia care (MAC).[64] Potential advantages to the use of anesthesia provider–administered sedation for routine colonoscopy and upper endoscopy may include improved patient satisfaction, decreased distractions for the endoscopist, and increased throughput through the endoscopy unit because of shorter sedation and recovery times, although there are no published studies confirming these. In addition, patients with medical comorbidities may require MAC that typically involves administration of propofol with or without adjunctive sedatives to achieve moderate sedation, deep sedation, or general anesthesia.[65,66] Governance to determine who can administer MAC is dictated by state and institutional regulations. In some instances, anesthesiologists

directly administer MAC or supervise certified registered nurse anesthetists. In other states, certified registered nurse anesthetists may administer MAC independently or under the direction of an endoscopist.

Several factors that may determine whether the assistance of anesthesia providers is needed include patient-specific risk factors for sedation, the planned depth of sedation, and the urgency and type of endoscopic procedure performed (Table 5).[67] Patient risk factors include significant medical conditions such as extremes of age; severe pulmonary, cardiac, renal, or hepatic disease; pregnancy; the abuse of drugs or alcohol; uncooperative patients; a potentially difficult airway for positive-pressure ventilation; and individuals with anatomy that is associated with more difficult intubation.[5,67] Additionally, an anesthesia provider may be used to provide propofol-based sedation for settings in which regulations or policies do not allow endoscopist-administered propofol, but the treating physicians judge the benefits of a propofol regimen to outweigh the risks and costs.

Studies have demonstrated that anesthesia provider–administered sedation for EUS-guided FNA of pancreatic masses and overtube-assisted enteroscopy is associated with improved outcomes.[68,69] Anesthesia provider–administered sedation is advantageous during ERCP, which often involves placing a patient in a prone position. The prone position may be associated with altered cardiovascular and pulmonary physiology and may involve limited airway access.[70]

However, for lower-risk patients (ASA I-III) undergoing non-advanced endoscopic procedures such as elective colonoscopy and EGD, recent large population–based studies found a higher risk of aspiration and other unplanned cardiopulmonary events in patients receiving deep sedation with propofol as administered by anesthesiologists, when compared with patients who received lighter sedation as administered by endoscopists.[71,72] Additionally, a recent study using claims data found a higher perforation rate in colonoscopies with anesthesia services.[73]

Currently, the cost of anesthesia-delivered propofol sedation is a separate charge from the endoscopy procedure and can range from $150 to $1500 per case. Despite the demonstration of no safety benefit, utilization of anesthesia services for low-risk endoscopic procedures such as EGD and colonoscopy continues to increase.[74,75] In a cost-effectiveness model, Hassan et al[76] showed that endoscopist-directed propofol sedation was more cost effective than anesthesia-administered propofol sedation. Dominitz et al[77] demonstrated in a large cohort study of Medicare beneficiaries that anesthesia-administered sedation for colonoscopy varies widely across regions and appears to be more associated with reimbursement practices (ie, Medicare contractors), rather than assessment of patient risk. This study also found no significant difference in the adenoma detection rate between endoscopist-directed or anesthetist-directed sedation.[77]

In summary, anesthesia provider–administered sedation most likely improves throughput, patient and/or endoscopist satisfaction, and endoscopist focus. In the setting of advanced endoscopic procedures such as EUS-guided FNA, it may also improve efficacy. Anesthesia provider–administered sedation is more expensive and does not appear to result in improved safety as compared with endoscopist-directed sedation for ambulatory endoscopic procedures such as upper endoscopy and colonoscopy.

PATIENT-CONTROLLED SEDATION

Patient-controlled sedation and analgesia with propofol and other agents is a method of sedation in which patients deliver their own drug via an infusion pump. Patient-controlled sedation has been studied in several randomized trials. Külling et al[78] showed that patients receiving patient-controlled sedation with propofol and/or alfentanil exhibited a high degree of patient satisfaction and more complete recovery at 45 minutes when compared with conventional sedation and analgesia. Ng et al[79] reported that patients undergoing colonoscopy with propofol patient-controlled sedation exhibited significantly shorter mean recovery times (43 vs 61 minutes; $P = .001$) and improved comfort compared with midazolam alone. Heuss et al[80] reported that younger and more anxious patients are less likely to agree to patient-controlled sedation. Currently, this method of procedural sedation remains under the purview of anesthesia providers.

RECOMMENDATIONS

1. We recommend that all patients undergoing endoscopic procedures be evaluated to assess their risk of sedation related to pre-existing medical conditions. ⊕⊕⊕⊕
2. We recommend that the combination of an opioid and benzodiazepine is a safe and effective regimen for achieving minimal to moderate sedation for upper endoscopy and colonoscopy in patients without risk factors for sedation-related adverse events. ⊕⊕⊕⊕
3. We suggest using an appropriate adjunctive agent (eg, diphenhydramine, promethazine, or droperidol) in combination with conventional sedative drugs in select clinical circumstances. ⊕⊕○○
4. We recommend that providers undergo specific training in the administration of endoscopic sedation and possess the skills necessary for the diagnosis and management of sedation-related adverse events, including rescue from a level of sedation deeper than that intended. ⊕⊕⊕⊕
5. We recommend the routine monitoring of blood pressure, oxygen saturation, and heart rate in addition to clinical observation for changes in cardiopulmonary status during all endoscopic procedures using sedation. Supplemental oxygen administration should

be considered for moderate sedation and should be administered during deep sedation. Supplemental oxygen should be administered if hypoxemia is anticipated or develops. ⊕⊕⊕⊕

6. We suggest that capnography monitoring be considered for patients undergoing endoscopy targeting deep sedation. ⊕⊕○○
7. We recommend anesthesia provider–administered sedation be considered for complex endoscopic procedures or patients with multiple medical comorbidities or at risk for airway compromise. ⊕⊕⊕○
8. We suggest that endoscopists use propofol-based sedation (endoscopist-directed or anesthesia-provider administered) when it is expected to improve patient safety, comfort, procedural efficiency, and/or successful procedure completion. ⊕⊕○○

DISCLOSURE

Dr Muthusamy is a consultant for Boston Scientific and received honoraria from Covidien GI Solutions. Dr Chathadi is a consultant for Boston Scientific. Dr Khashab is a consultant for Boston Scientific. He is on their advisory board and has received grants from them. He is a consultant for Olympus America and has received grants from Cook Medical. All other authors disclosed no financial relationships relevant to this publication.

Abbreviations: ASA, American Society of Anesthesiologists; ASGE, American Society for Gastrointestinal Endoscopy; BPS, balanced propofol sedation; ECG, electrocardiogram; MAC, monitored anesthesia care; NAAP, non-anesthesiologist–administered propofol sedation; NAPS, nurse-administered propofol sedation; RN, registered nurse.

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