

ADVANCES IN ENDOSCOPY

Current Developments in Diagnostic and Therapeutic Endoscopy

Section Editor: John Baillie, MB ChB, FRCP

Recent Advances in Endoscopy Sedation: The Anesthesiologist's Perspective



Raymond C. Roy, MD, PhD
Professor Emeritus of Anesthesiology
Wake Forest Baptist Medical Center
Winston-Salem, North Carolina

G&H How has the endoscopy sedation landscape changed over the past few years?

RR Four changes come to mind. The first relates to the anesthesia providers themselves. We are better now because we have a local awareness of what has become apparent nationally: If a busy gastrointestinal (GI) endoscopy unit is staffed on a daily basis with a small team of anesthesia providers who are frequently assigned there rather than with a larger group of equally competent providers who are infrequently assigned there, several benefits accrue. Efficiency increases. The comfort level with deep sedation rather than general endotracheal anesthesia for complex endoscopy increases. A better understanding of why the endoscopy suite is preferred over the operating room for complex endoscopy in very sick patients is acquired. With a greater appreciation of the challenges of providing sedation and anesthesia for GI procedures in patients with a wide range of medical problems comes a professional and academic satisfaction in concentrating a significant portion of one's activity.

The second change is a better understanding of the most common mechanism causing hypoxemia during deep sedation with propofol. The best way to address this issue is to focus on pharyngeal volume—factors that decrease it and ways to increase it.

The third change, which occurred in 2013, was the US Food and Drug Administration's premarket approval of a computer-assisted personalized sedation device (Sedasys, Ethicon Endo-Surgery), which was designed to provide minimal to moderate propofol sedation to patients with American Society of Anesthesiologists physical status I or II who were undergoing routine esophagogastroduodenos-

copy or screening colonoscopy. Presumably, this device will reduce the need to assign a sedation nurse to each patient for each procedure that does not involve an anesthesia team.

The last change involves drug shortages that have occasionally affected the availability of generic drugs commonly used to provide sedation and anesthesia, both for gastroenterologists and for anesthesiologists. When the anesthesia team is forced to modify its protocols and techniques, unit efficiency may be reduced, new recovery issues may develop, drug administration mistakes may become more likely because of the use of less familiar drugs, and patient safety and satisfaction may suffer.

G&H Could you further discuss the mechanism of hypoxemia during sedation for endoscopy?

RR There must be sufficient space (ie, pharyngeal volume) for air and oxygen to gain access to the glottic opening for adequate ventilation and oxygenation. Endoscopes currently occupy some of that space; we look forward to the arrival of slimmer endoscopes that will take up less pharyngeal volume. Patients with obstructive sleep apnea anatomically have a smaller-than-normal pharyngeal volume. Obese patients lose pharyngeal volume with the accumulation of fatty tissue in the pharyngeal wall. Pharyngeal volume is decreased by edema in patients with congestive heart failure (CHF) or hypoproteinemia from liver or renal disease. Pharyngeal volume is also decreased by lymphadenopathy in patients with cancer or upper respiratory infections (URIs) that are active and resolving. Finally, we now know that pharyngeal volume decreases with the increasing blood concentration of propofol and even disappears with airway collapse.

To increase pharyngeal volume, the edema in patients with CHF, ascites, or nephrotic syndrome should be reduced, and the lymphadenopathy in patients with URIs should be allowed to resolve before elective upper endoscopy is performed. In patients with a high likelihood of presenting with decreased pharyngeal volume, we proceed along 2 lines of attack. First, we decrease the propofol dose requirement by the selective coadministration of lidocaine, ketamine, fentanyl, or remifentanyl. Second, we prepare the patient for insertion of a nasopharyngeal airway. The nasal passage is pretreated with a vasoconstrictor to diminish the incidence of nosebleed, and then a lubricated nasopharyngeal airway is inserted. Occasionally, just the insertion alone allows sufficient oxygen to reach the glottis. More frequently, the nasopharyngeal airway is attached to a transport circuit to provide positive airway pressure with a 6-L oxygen flow or to the circle system on the anesthesia machine with high gas flows (eg, 20 L/min of oxygen and air) to create turbulence that exerts pressure on the pharyngeal wall to increase pharyngeal volume.

G&H Is there a role for patient-administered propofol for endoscopy sedation?

RR The feasibility of patients self-administering propofol for procedural sedation has been well demonstrated. The system that I have read about most is the one developed by Dr Jeff Mandel of the University of Pennsylvania, which allows patient control of an infusion of propofol and remifentanyl. Patient-administered propofol systems typically allow the patient to control the maintenance of sedation after he or she is given an induction dose. The induction dose is determined by pharmacokinetic and pharmacodynamic algorithms based on patient data, such as age, weight, and assessment of sensitivity to propofol. To date, all such systems have been experimental, but I think that they will be the successors to the computer-assisted personalized sedation device, which has yet to be widely implemented. Patient-administered propofol systems are to be differentiated from the computer-assisted personalized sedation device because the latter is not a patient-administered system. With the computer-assisted personalized sedation device, the gastroenterologist sets an infusion rate that the device can maintain, reduce, or discontinue based on capnography and an automated responsiveness monitor that asks the patient to push a button at various time intervals.

G&H Should nonanesthesiologists, including nurses, administer propofol for endoscopic procedures?

RR Ignoring the fact that this is an off-label use of propofol, the most important requirements for the person

administering the agent is that he or she be an individual who is attentive to the patient, recognizes the signs of hypoventilation and airway obstruction, is skilled in the application of corrective measures, and understands monitoring. Evidence suggests that this person does not have to be an anesthesia provider when minimal to moderate sedation is involved. In theory, monitors such as pulse oximeters and capnographs provide a safety net, although I view them as double-edged swords; sedation providers may pay more attention to the monitors than to the patient instead of treating both as important sources of information. Because of drug accumulation issues and the increased likelihood of deep sedation, I become increasingly concerned with a provider's experience when administration takes longer than 15 minutes. Likewise, I prefer that anesthesiologists and certified registered nurse anesthetists administer propofol to elderly patients because of increased comorbidities, decreased dose requirements, and narrower therapeutic windows.

G&H Are there any new drugs in the pharmaceutical pipeline that may increase the safety of intravenous sedation?

RR I am excited about remimazolam, a benzodiazepine whose onset time is one-half that of midazolam and whose half-life after a 2-hour infusion is only 6 minutes, compared with 27 minutes for midazolam. Although remimazolam has undergone only phase 1 trials so far, I foresee remimazolam-fentanyl eventually replacing midazolam-fentanyl and even propofol for minimal to moderate sedation.

G&H Although capnography is commonly used during deep anesthesia, does it make standard intravenous (conscious) sedation safer?

RR There are 2 ways to answer this question, physiologically and economically. Physiologically, the question is more complex than might be expected because it depends on whether supplemental oxygen is being provided during sedation. The pulse oximeter is a poor monitor for ventilation with higher levels of inspired oxygen that increase the patient's oxygen reserve in the lungs. Under these conditions, a patient can be apneic for more than a minute without a decrement in the pulse oximeter reading. Thus, a strong argument for capnography can be made as an earlier monitor for apnea or airway obstruction that can be corrected before the patient becomes hypoxemic. Admittedly, the pulse oximeter is a better monitor of ventilation when the patient is breathing room air, but the need-to-rescue response time that the sedation provider has in which to correct the situation is shorter because the patient has little to no oxygen reserve when

the airway obstruction is detected. With deep sedation, the incidence of hypoxemia in well-performed studies ranges from 20% to 40% in patients receiving room air.

However, the question is not about deep sedation but about minimal to moderate sedation, during which fewer than 5% of patients are likely to become hypoxicemic from hypoventilation or airway obstruction. When I ask myself whether using capnography allows me to detect apnea or airway obstruction earlier than with a precordial stethoscope, I want the answer to be no. But being human, and therefore distractible, and because I frequently have other things to do while administering sedation (such as drawing up drugs and recording their administration, helping the endoscopist with patient positioning, and preparing for the next patient), I must admit that I want the safety net that capnography provides. Is the cost of capnography worth the benefit during minimal to moderate sedation, based on complications avoided rather than decreased surrogate markers of untoward events, such as fewer easily correctable hypoxicemic episodes? I admit that there are insufficient data to support my preference.

Absent cost-benefit data, there are strong opinions for and against the use of capnography. My biased view is that those arguing against capnography must address the following 3 issues. First, anesthesia providers are the strongest advocates of capnography but are probably the ones best trained to administer sedation without it. Sedation nurses may be more susceptible to pressure from a demanding gastroenterologist to exceed their comfort zone by giving more propofol and crossing the line to deep sedation. Even the computer-assisted personalized sedation device uses capnography to determine respiratory rates and is programmed to order the patient to take a deep breath and/or stop the infusion of propofol when the patient becomes unresponsive or breathes inadequately. Second, the propofol effect-site concentration between a patient moving too much in response to endoscopic manipulations during moderate sedation and the patient not moving under deep sedation may be the difference of 1 propofol bolus, especially in older patients. Third, in the setting where the pulse oximeter might serve as an indicator of hypoventilation and possibly obviate the need for capnography (ie, room air sedation), the incidence of hypoxemia is high enough that it would be difficult to secure approval of a hospital standard for sedation providers in the United States that did not require supplemental oxygen.

G&H What are the pros and cons of prone vs supine positioning for anesthesia during prolonged endoscopic procedures?

RR Because I believe that endoscopic retrograde cholangiopancreatography should typically be performed with the

patient under deep sedation in the semiprone position in the endoscopy suite, I am concerned with anything that causes deviation from the 3 elements in this statement—that is, using general anesthesia rather than deep sedation, a supine position rather than a prone position, and an operating room rather than the endoscopy suite. There are important medical and anesthetic reasons to deviate from the ideal for the first 2 elements. Typically, these patients have recent abdominal incisions and drains, a strong likelihood of postoperative ileus, an increased aspiration risk, or super morbid obesity. Because there is a greater incidence of hypoxemia and a greater risk of aspiration in the supine position than in the semiprone position, I always intubate these patients. Other reasons for this decision are that the supine position increases the degree of difficulty for the endoscopist and that general endotracheal anesthesia limits distractions related to patient movement or airway management issues during the procedure. I no longer accept the argument that a patient is too sick for the endoscopy suite and must be anesthetized in the operating room. The endoscopy suite is where the endoscopist is most likely to accomplish what he or she needs to do.

With regard to endoscopic ultrasound–guided fine-needle aspirations, we demonstrate daily that these longer procedures can be performed safely with deep sedation. However, I believe in having frequent conversations with the gastroenterologist regarding the possibility of delayed gastric emptying and increased gastric volume and the need for endotracheal intubation. On occasion, we are surprised by an unexpectedly high volume of gastric contents and must convert from sedation to general endotracheal anesthesia. We look forward to the day when gastric volume can be measured with surface ultrasound before the procedure is performed in selected patients. We have the technology to do this.

Dr Roy has no relevant conflicts of interest to disclose.

Suggested Reading

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