Providing Deep Sedation for Advanced Endoscopic Procedures: The Esthetics of Endoscopic Anesthetics

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With gastroenterologists firmly established as therapeutic endoscopists, the anesthesia requirements for advanced endoscopic procedures are approaching those of specialized surgical interventions. It is often stated that although there are minor surgeries, there is no such thing as minor anesthetics. Stated another way, “monitored anesthesia care” (more recently referred to as “deep sedation”) is just as risky as general anesthesia administered in a standard operating room (OR). Indeed, the available evidence suggests that the risks of providing anesthesia in locations such as endoscopy suites are higher than in conventional ORs. Our own study highlighted the dangers of providing deep sedation for patients undergoing all types of endoscopic procedures: The risk of propofol sedation for interventional procedures such as endoscopic retrograde cholangiopancreatography (ERCP), endoscopic ultrasound, and therapeutic endoscopy are among the highest for any sedated endoscopic procedure. The reasons are many: The intensity of stimulation encountered during these procedures is similar to many minor surgeries; the airway management is complex and requires constant attention; the incidence of hypoxemia is high, and the time available for recognition and management is limited; and finally, there are several cases of venous air embolism reported during ERCP and esophageal balloon dilation [1–3]. In our analysis, we cited studies such as one by Metzner et al. [4] who in their

analysis of anesthesia-related claims concluded that ~50 % of all out-of-OR-related deaths occurred during gastrointestinal (GI) endoscopy, and about half of these deaths were sedation-related. A more recent study concluded that propofol sedation is associated with a 13 % increase in all complications in patients undergoing colonoscopy. Providing sedation for GI endoscopy is thus an area with many undisputed challenges, controversies, and even some conspiracy theories [5, 6].

In the current issue of *Digestive Diseases and Sciences*, Mizrah et al. [7] report the findings of their investigation into the impact of anesthesia and deep sedation on the efficacy of esophageal radiofrequency ablation (RFA) procedures. Specifically, they conducted a retrospective chart review of 120 consecutive patients who underwent RFA for esophageal dysplasia or for intestinal metaplasia, analyzing the frequency of sedation-related adverse events (SRAE) and their relationship to the number of treatment sessions needed for complete dysplasia eradication. In general, the frequency of SRAEs was high in patients receiving both general endotracheal anesthesia (GET) and deep sedation. Such events are common in patients undergoing advanced endoscopic procedures [8]. While hypoxemic events were more frequent with deep sedation, cardiovascular events appeared more frequently with GET. Both of these findings are not surprising to the anesthesia providers practicing in the area of GI endoscopy since GET requires administration of higher doses of induction agents along with maintenance agents and a proportionate decrease in the systemic vascular resistance. Institution of positive pressure ventilation decreases the cardiac preload by increasing the mean intrathoracic pressure. Both of these factors, along with associated intravascular volume depletion in some patients, were thought contributory to the etiology of the observed cardiac events. Again, predictably,

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respiratory events were more frequent in patients who were administered deep propofol sedation. It is also not surprising that the length of sedation and the use of GET had significant association with the occurrence of SRAE.

Nevertheless, more concerning is the association between the occurrence of SRAE and the number of RFAs needed to achieve complete eradication of dysplasia. In addition to increasing the number of treatments necessary to achieve satisfactory results, SRAEs might decrease patient satisfaction, cooperation, and compliance. Problematic sedation may also be responsible for ineffective or failed treatment. Frequent coughing and desaturation might necessitate withdrawal of the endoscope and at times termination of the procedure. The endoscopist might try and finish the procedure in a hurry and as a result might not achieve the intended results.

That a large number of patients need GET likely mirrors the challenges involved in providing deep sedation for these advanced procedures. In the anesthesia world, keeping patients immobile is considered crucial for the success of many surgical procedures. Indeed, some procedures such as posterior chamber ophthalmological and video-assisted thymectomy necessitate deep akinesia. Even minimal movement of patients during these procedures will increase the surgical difficulty along with heightened risk of serious iatrogenic injuries. Although complete akinesia is unnecessary for advanced endoscopic procedures, excessive patient movement is unwelcome as well.

Dedicated Team of Anesthesia Providers

Having a small core group of anesthesia providers to deliver sedation for all endoscopic procedures increases safety and efficiency [9]. The importance of a dedicated and experienced core group is that many anesthesiologists and nurse anesthetists are relatively inexperienced in sedation for endoscopic procedures. Indeed, sedation for endoscopic procedures is not part of the curriculum of most anesthesiology and student registered nurse anesthetist (SRNA) training programs. Due to its inherent risky nature, including fear of losing the airway and the time commitment required to train adequately, many providers altogether avoid providing sedation for endoscopic procedures.

Choice of Drugs and Airway Management

Propofol is *sine qua non* agent used for gastroenterological endoscopic sedation. Although the safety of propofol in endoscopic sedation has been questioned repeatedly, it continues to be a popular anesthetic [5]. One of the major drawbacks of propofol for endoscopic sedation is its

enormous pharmacologic variability, calculated at 300–400 % [10], which, when further amplified by the use of opioid adjuvants, is thought responsible for unpredictable sedation depth, especially in the elderly. What is considered an appropriate sedative dose of propofol for one patient might produce apnea in the next. In general anesthesia, the airway is largely protected and as a result drug effect variability is less of a concern. With an unprotected airway, suboptimal under- or oversedation might have unwelcome and occasionally disastrous consequences. Too little can trigger coughing and rarely laryngospasm, whereas too much is responsible for apnea, both of which can produce hypoxemia, in particular in moderate intensity procedures such as RFA. An observant and trained anesthesia provider will be able to anticipate this variability and take appropriate measures, to prevent and to treat hypoxemia.

Although many other sedative agents are used prior to and during endoscopy, none approach propofol in terms of desirable properties. Intravenous conscious sedation typically using a combination of a benzodiazepine like midazolam and a short-acting opioid like fentanyl has its proponents. Although the combination is safe and acceptable for screening colonoscopy and diagnostic endoscopy, it is inadequate in terms of patient and endoscopist satisfaction for advanced endoscopic procedures. The speed of onset of dexmedetomidine (another sedative) is unacceptably long, although it produces less respiratory depression. Although remimazolam (a newer benzodiazepine) is undergoing clinical trials, its initial results were disappointing [11], since a significant number of patients needed additional medications or were converted to propofol sedation.

In view of the limitations of the many drugs currently available, it is essential to have a repertoire of techniques to regulate sedation and treat any unwanted consequences. Continuous propofol infusion along with a short-acting opioid is a popular method of administration. The safety of such a technique can be further enhanced by a variety of airway management options [12]: (1) depth-of-sedation monitors have documented the difficulty inherent in providing moderate-to-deep sedation for patients undergoing endoscopy [13]; (2) unexpected deep sedation might require chin lift and jaw thrust to open an obstructed upper airway, simple measures that are often ignored or implemented late; (3) there should be a low threshold for airway intervention, if dangerous hypoxemia is anticipated in patients with low pulmonary reserve and morbid obesity; and (4) a face mask and portable ventilating system (Mapleson C or Ambu) should be readily available and the practitioner be prepared to use them on very short notice. Intelligent anticipation and active involvement of an anesthesiologist are critical to the success of deep sedation in endoscopy.

Selection of Anesthesia Technique Based on the Comorbidity

The safest result can only be achieved if one tailors the technique to individual patient needs. Sedation rooms (especially inpatient) receive patients ranging from American Society of Anesthesiology (ASA) physical classification I–IV [14]. Constant adjustment to the patient's fluctuating medical/surgical condition forms the crux of the management, which usually comes with experience. It is important to have a low threshold for endotracheal intubation for inpatients undergoing complicated endoscopic procedures including ERCP.

Non-anesthesia Provider-Administered Propofol Sedation

A surprising finding of our recent meta-analysis was increased safety associated with non-anesthesia provider-administered propofol sedation (NAAP) in patients undergoing advanced endoscopic procedures. One of the likely reasons was a reduced amount of propofol administered. NAAP was also associated with decreased endoscopist and patient satisfaction. It is also possible that the endoscopists involved in the studies were well versed with propofol sedation and included a motivated group of gastroenterologists. One of the solutions might be to train a dedicated group of nurses in propofol administration techniques. The routine use of Sedasys^R, a novel computer-aided propofol infusion device, awaits a drug suitable for such an administration technique [11]. It is hoped that the device, which was withdrawn from the US market on March 10, 2016, can be appropriately resurrected.

In conclusion, in order to reap the benefits of advanced endoscopic procedures like RFA, anesthesia providers must rise to the challenge. This requires a dedicated group of anesthesia providers practicing safe, efficient, and effective sedation techniques for advanced endoscopic procedures. Ongoing research into safer drugs, novel infusion methods, and the invention of newer airways can add safety to the existing sedation techniques and address some of the concerns related to hypoxemia [15].

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