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An Overview on Anesthetic considerations for Upper Gastrointestinal Tract Endoscopy

Ahmed Esam Hamad Abdeldayem, Doaa Mohamed Farid, Olfat Abdelmoniem Ibrahem, Nader Mohamed Farag, Rehab Abd -Allah Wahdan

Anaesthesia , Intensive Care and Pain Management Department, Faculty of Medicine, Zagazig University, Egypt

***Corresponding author:** Ahmed Esam Hamad Abdeldayem

Email: Tahawy188 @ gmail.com,

Abstract:

Upper gastrointestinal endoscopy requires careful anesthetic planning because sedation must provide patient comfort, suppress airway reflexes, and maintain cardiorespiratory stability while sharing the airway with the endoscopist. Sedation strategies vary according to procedure type, ranging from routine diagnostic endoscopy to advanced therapeutic interventions such as endoscopic retrograde cholangiopancreatography and endoscopic mucosal resection, where deeper sedation or general anesthesia may be required. This review summarizes anesthetic considerations for upper Gastrointestinal (GI) endoscopy, including airway management, aspiration risk, hemodynamic effects, sedation techniques, monitoring standards, and peri-procedural care. Special emphasis is placed on high-risk populations such as elderly and frail patients, those with cardiovascular disease, and patients with obesity or obstructive sleep apnea, in whom individualized anesthetic approaches and enhanced monitoring are essential to optimize safety and outcomes.

Keywords: Upper gastrointestinal endoscopy; Sedation; Propofol; Airway management; Capnography; ERCP; Endoscopic mucosal resection .

Introduction:

Due to the nature of the technique and the shared airway, upper GI endoscopy poses special sedation and safety issues. The oropharynx and upper esophagus must be traversed by the endoscope, which increases the risk of laryngospasm, triggers gag and cough reflexes, and increases the likelihood of airway obstruction. Therefore, sedation should preserve enough spontaneous breathing and airway patency while balancing enough depth to inhibit these reflexes and guarantee patient comfort. Because of its quick onset and consistent suppression of gag reflexes, propofol is frequently used in conjunction with a short dosage of midazolam or an opioid [(1)].

The main focus of upper GI endoscopy is airway management. The anesthetist's capacity to manually maintain airway patency in the event of obstruction is diminished by the procedure's requirement that the patient's mouth stay open, often with a bite block in place. Particularly in recumbent or obese patients, sedated patients may experience tongue fall, partial airway collapse, or total obstruction. Risk is decreased by careful placement with a small head tilt, chin raise, and additional oxygen (by nasal cannula or high-flow oxygen). Since early detection of hypoventilation enables prompt correction, continuous monitoring with pulse oximetry and, ideally, capnography is highly advised [(2)].

Another important consideration is aspiration risk. Even with pre-procedure fasting regimens, patients with gastroesophageal reflux disease, hiatal hernias, or delayed gastric emptying may experience reflux or residual stomach contents. Careful patient selection and dosage are crucial since sedation-induced suppression of protective airway reflexes increases the risk of aspiration. Endotracheal intubation may be preferable to heavy sedation for certain high-risk individuals [(3)].

Hemodynamic effects must also be taken into account. While the sympathetic stimulation caused by scope insertion may momentarily raise heart rate and blood pressure, propofol-induced vasodilation and negative inotropy typically predominate, making hypotension more likely. Dosage titration and being prepared to administer fluids or vasopressors are crucial because patients with cardiac comorbidities may be particularly sensitive [4].

Therapeutic Endoscopic Retrograde Cholangiopancreatography ERCP/ Endoscopic Mucosal Resection (EMR)

Compared to routine diagnostic upper GI endoscopy or colonoscopy, therapeutic endoscopic retrograde cholangiopancreatography (ERCP) and endoscopic mucosal resection (EMR) require deeper, more stable sedation because they are longer, more technically complex, and frequently more uncomfortable for the patient. Careful planning is crucial because the intricacy of the intervention increases procedural and sedation-related risks [5].

In order to perform procedures like sphincterotomy, stent implantation, or stone extraction, the endoscope is placed in the duodenum for an extended amount of time. To enable precise endoscopic procedures, this necessitates almost total immobility and consistent suppression of the gag and retching reflexes. ERCP frequently necessitates prone or semi-prone positioning, which makes airway access more difficult in the event of obstruction or apnea, in contrast to diagnostic gastroscopy. Because of this, many facilities favor general anesthesia with a secured airway or propofol-based deep sedation for high-risk patients, such as those with obesity, obstructive sleep apnea, or planned lengthy interventions. Because desaturation is more likely in prone patients, where rescue maneuvers are more challenging, it is imperative to continuously monitor oxygenation, breathing (capnography), and hemodynamics [6].

Because of deeper sedation, longer drug exposure, and vagal reactions during instrumentation, hemodynamic changes are frequent in both ERCP and EMR. It is important to predict and treat hypotension and bradycardia using fluids, atropine, or vasopressors as needed. Additionally, prone placement in ERCP puts patients at risk for hypoventilation, hypercapnia, and hypoxemia, necessitating close monitoring and additional oxygen. It may be safer to use general anesthesia with intubation rather than deep sedation in certain people with major comorbidities [7].

Duration and possible bleeding risk are the main concerns for EMR. Patient movements or coughing could compromise accuracy and safety during lengthy EMR operations that call for meticulous mucosal dissection, injection, and resection. In order to prevent respiratory depression, the level of sedation must be both deep enough to render the patient immobile and titrated. Since the upper GI tract mucosa is less insensitive to discomfort, analgesia is less of an issue than colonoscopy; however, reflex suppression and anxiety management are still crucial. To produce stable sedation with lower cumulative medication dosages, propofol is frequently used either alone or in conjunction with adjuvants such ketamine or dexmedetomidine [8].

Monitoring & standards of care

In gastrointestinal (GI) endoscopic sedation, standards of care and monitoring are intended to optimize patient safety while guaranteeing comfort and successful procedures. Hypoventilation, hypoxemia, hypotension, arrhythmias, and delayed recovery are among the dangers associated with sedation in this context, which might range from minor anxiolysis to substantial sedation. Strict monitoring procedures and adherence to evidence-based standards of care are crucial due to these dangers [9].

Continuous pulse oximetry to monitor oxygen saturation, non-invasive blood pressure checks at regular intervals, and electrocardiography (ECG) in patients with cardiovascular risk factors or undergoing sophisticated procedures like ERCP are all standard monitoring during sedated GI endoscopy. Because capnography enables early diagnosis of hypoventilation and apnea before desaturation begins, it is becoming more widely acknowledged as best practice, especially for heavy sedation with propofol. Trained workers should regularly monitor respiratory rate and effort, particularly in individuals with obesity or obstructive sleep apnea [10].

Personnel and training are also emphasized by standards of care. Monitoring the patient's state of awareness, airway, ventilation, and hemodynamic status should be the exclusive responsibility of at least one healthcare professional, separate from the anesthesiologist. Because crises can happen at any time, these people need to be trained in advanced airway management and resuscitation. Vital signs should be recorded at baseline, frequently during the surgery, and during the recovery period. The endoscopy suite must have airway rescue equipment on hand right away, including advanced devices, bag-mask ventilation, oral/nasal airways, and suction [(9)].

Another crucial component of standards is documentation. Using validated scales like the Ramsay Sedation Scale, MOAA/S, or Observer's Assessment of Alertness/Sedation, sedation depth should be routinely measured and documented. Following endoscopy, patients must be monitored until they fulfill predetermined recovery and discharge criteria, which are frequently evaluated using instruments like the Aldrete or Post-Anesthetic Discharge Scoring System modified PADSS score [(11)].

Guidelines supporting these principles have been issued by international organizations including the American Society of Anesthesiologists (ASA), American Society for Gastrointestinal Endoscopy (ASGE), and European Society of Gastrointestinal Endoscopy (ESGE). Individualized risk assessment before to sedation, suitable patient fasting, pre-procedure airway assessment, and rigorous adherence to monitoring guidelines along the sedation continuum are among the fundamental recommendations [(9)].

Special populations / modifiers

- **The elderly and frail cardiac patients**

Because their physiology and comorbidities raise the risk of adverse events, patients who are elderly, weak, or have major heart illness require specialized sedation techniques during gastrointestinal endoscopy. Individualized dose and improved monitoring are crucial because these populations are especially susceptible to hemodynamic instability, oversedation, and delayed recovery [(12)].

Elderly people are more susceptible to sedatives due to altered pharmacokinetics and pharmacodynamics. Standard adult dosages frequently result in exaggerated effects due to decreased hepatic metabolism, renal clearance, and enhanced brain sensitivity to medications like benzodiazepines and propofol. Due to decreased physiological reserve, polypharmacy, and numerous comorbidities, frail patients—even those who are not elderly—share comparable vulnerabilities. With a propensity for short-acting medications that enable quick adjustment and recovery, sedation for these groups should start with lower dosages and be carefully titrated to effect. After discharge, longer-acting sedatives such midazolam may raise the risk of falls, delirium, or extended sleepiness [(13).]

Cardiac Patients

Cardiac illness patients provide additional difficulties. Although propofol is useful for profound sedation, its vasodilatory and negative inotropic effects might result in hypotension and bradycardia. Patients with ischemic heart disease, heart failure, or valve malfunction may not tolerate propofol well. In a similar vein, excessive opioid dosages may worsen hypotension or induce vagally mediated bradyarrhythmias. It is advised to manage fluids carefully, titrate sedatives more slowly, and be prepared to use vasopressors or anticholinergics (such atropine). For patients with coronary artery disease, low ejection fraction, or known arrhythmias, continuous ECG monitoring is highly recommended [(14)].

Maintaining proper oxygen flow and preventing severe respiratory depression are important goals for both cardiac and frail patients. Since hypoxemia or hypercapnia can quickly destabilize these patients, extra oxygen, careful monitoring of respiratory effort, and the use of capnography are particularly crucial. Additionally, positioning should be taken into account because in impaired people, supine or prone positions may decrease cardiac output and respiratory mechanics [(15)].

These groups often recover more slowly, old and weak patients are more likely to experience post-procedure delirium. Discharge planning should include counseling regarding residual sedation effects, fall prevention measures, and refraining from driving or making decisions for at least 24 hours. They should stay in monitored settings until they meet all recovery criteria [(16)].

- **Obstructive sleep apnea /obesity**

Due to their heightened vulnerability to airway obstruction, hypoventilation, hypoxemia, and hemodynamic instability, patients with obstructive sleep apnea (OSA) and obesity constitute another high-risk group for gastrointestinal endoscopic sedation. Careful planning, careful medication titration, and improved airway monitoring are necessary for sedation in these patients [(17)].

By decreasing lung compliance, diaphragmatic excursion, and functional residual capacity, obesity modifies respiratory physiology and puts patients at risk for rapid desaturation during apnea. This danger is increased in OSA, where blockage is more likely once sedation is started due to upper airway collapsibility and reduced arousal responses. For many patients, even mild sedation can result in severe hypoxemia. Consequently, it is highly advised to employ techniques like pre-oxygenation, the use of additional oxygen during the process, and capnography for the early diagnosis of hypoventilation. Advanced airway equipment should be easily accessible in the endoscopy unit, and providers must be ready for challenging mask ventilation or intubation [(18)].

Pharmacologically, people with OSA and obesity are more susceptible to the sedative and opioid effects, especially respiratory depression. Propofol is still often used, however in order to prevent overdosing, dosage should be modified and usually determined using lean body weight or adjusted body weight rather than total body weight. Adjuvant medications such dexmedetomidine or low-dose ketamine can minimize respiratory impairment, improve hemodynamics, and lower the overall amount of propofol needed. Because of their combined depressive effects on breathing, benzodiazepines and opioids should be administered with caution [(17)].

Another important factor is positioning. While prone placement in ERCP may worsen airway access, semi-upright or reverse Trendelenburg positioning during upper endoscopy can enhance airway patency and oxygenation in obese patients, necessitating constant care [(19)].

Recovery after the operation is also more difficult. Patients with OSA and obesity are more likely to experience delayed hypoxemia in the recovery area, airway obstruction, and persistent sedation. Until they are completely awake and able to sustain stable oxygen saturation without assistance, they need to be observed for an extended period of time. Patients with known OSA may occasionally be encouraged to bring their Continuous Positive Airway Pressure (CPAP) devices for use following the operation, especially if lengthier interventions or moderate-to-deep sedation are scheduled [(20)].

References:

1. **Lin S (2017):** Sedation for Routine Gastrointestinal Endoscopic Procedures: A Review on Efficacy, Safety, Efficiency, Cost and Satisfaction. Intest Res., 15(4):456-66.
2. **Goudra B, Singh M (2017):** Airway Management During Upper GI Endoscopic Procedures: State of the Art Review. Dig Dis Sci., 62(1):45-53.
3. **Joshi P, Abdelmalak B, Weigel A et al. (2023):** 2023 American Society of Anesthesiologists Practice Guidelines for Preoperative Fasting: Carbohydrate-containing Clear Liquids with or without Protein, Chewing Gum, and Pediatric Fasting Duration - A Modular Update of the 2017 American Society of Anesthesiologists Practice Guidelines for Preoperative Fasting. Anesthesiology, 138(2):132-151.
4. **Sahinovic M, Struys F, Absalom R (2018):** Clinical Pharmacokinetics and Pharmacodynamics of Propofol. Clin Pharmacokinet., 57(12):1539-1558.
5. **Greaves G, Harding G, Parker B et al. (2024):** Endoscopic Retrograde Cholangiopancreatography Under General Anesthesia Compared to Conscious Sedation Study. J Can Assoc Gastroenterol., 7(2):154-159.
6. **Zhang C, Ganion N, Knebel P et al. (2020):** Sedation-related Complications During Anesthesiologist-administered Sedation for Endoscopic Retrograde Cholangiopancreatography: A Prospective Study. BMC Anesthesiol., 20(1):131.
7. **van der Star S, Moons G, ter Borg F et al. (2020):** Management of Delayed Bleeding After Endoscopic Mucosal Resection of Large Colorectal Polyps: A Retrospective Multi-center Cohort Study. Endosc Int Open., 8:E1052-E1060.

8. **Triantafyllou K, Sidhu R, Tham T et al. (2024):** Sedation Practices in Gastrointestinal Endoscopy: European Society of Gastrointestinal Endoscopy Survey. Endoscopy, 56(12):964-974.
9. **Andrade J, Solà-Valls M, Lucena I (2017):** The Challenge of Hepatotoxicity by Drugs in Clinical Practice: The Spanish Perspective. Dig Dis., 35(5):433-438.
10. **Ding D, Ishag S (2023):** Aldrete Scoring System. In: StatPearls. Treasure Island (FL): StatPearls Publishing.
11. **Sidhu R, Turnbull D, Haboubi H et al. (2023):** British Society of Gastroenterology Guidelines on Sedation in Gastrointestinal Endoscopy. Gut, 72:1-27.
12. **Gronich N (2024):** Central Nervous System Medications: Pharmacokinetic and Pharmacodynamic Considerations for Older Adults. Drugs Aging., 41(6):507-520.
13. **Aboian M, Johnson M, Ginat T (2023):** Propofol. In: Neuroimaging Pharmacopoeia. 2nd ed. Cham: Springer International Publishing. p.281-283.
14. **Conway A, Rolley J, Sutherland R (2016):** Midazolam for Sedation Before Procedures. Cochrane Database Syst Rev., (5):CD009491.
15. **Benzoni T, Agarwal A, Cascella M (2023):** Procedural Sedation. In: Pediatric Surgery: Diagnosis and Treatment. p.47-63.
16. **Chaudhry A, Zarmer L, West K et al. (2024):** Obstructive Sleep Apnea and Risk of Postoperative Complications After Non-Cardiac Surgery. J Clin Med., 13(9):2538.
17. **Slowik M, Sankari A, Collen F (2025):** Obstructive Sleep Apnea. In: StatPearls. Treasure Island (FL): StatPearls Publishing.
18. **Hassan A, Baraka E (2021):** The Effect of Reverse Trendelenburg Position Versus Semi-recumbent Position on Respiratory Parameters of Obese Critically Ill Patients: A Randomised Controlled Trial. J Clin Nurs., 30(7-8):995-1002.