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The Anesthetic Challenge of Sedation for Upper Gastrointestinal Endoscopy in Class III Obesity

A Case-Based Multimodal Approach with Focused Literature Review

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ABSTRACT

Background: Sedation for upper gastrointestinal endoscopy in patients with severe obesity is challenging because reduced functional residual capacity, increased upper-airway collapsibility, frequent sleep-disordered breathing, and sedative-induced ventilatory depression can produce rapid hypoxemia. High-flow nasal oxygen (HFNO) and non-pharmacological adjuncts such as immersive virtual reality (VR) may complement careful titration of propofol. Case presentation: A 35-year-old woman with class III obesity (body mass index 46 kg/m²) and arterial hypertension treated with amlodipine was scheduled for preoperative esophagogastroduodenoscopy before sleeve gastrectomy. Routine laboratory investigations were unremarkable. Sedation was performed with propofol target-controlled infusion (TCI) using the Marsh model; Immersive VR was used as a distraction/anxiolytic adjunct. Heated and humidified HFNO was delivered at 69 L/min, 37°C, with FiO₂ 0.50. The endoscopy was completed using this multimodal strategy.

Discussion: Patients with class III obesity have limited respiratory reserve and increased susceptibility to upper-airway obstruction during propofol sedation. The HFNO settings used in this case closely resemble those evaluated in the ODEPHI trial (70 L/min, FiO₂ 0.50), in which HFNO reduced SpO₂ ≤92% from 33.5% to 9.4%. A 2025 multicenter randomized trial in 984 patients with obesity reduced hypoxia from 21.2% to 2.0% with HFNO. Nevertheless, a 2026 randomized trial in obese patients undergoing gastroscopy showed that HFNO reduced desaturation while apnea remained frequent, emphasizing that improved oxygenation does not guarantee adequate ventilation. Conventional Marsh pharmacokinetics also have limitations at extremes of body weight; TCI targets should therefore be interpreted as a titration framework rather than an absolute pharmacodynamic endpoint. VR is promising for

reducing anxiety and may reduce sedative exposure, but evidence remains heterogeneous and its respiratory-protective role is unproven.

Conclusion: Sedation for gastroscopy in class III obesity should be treated as a high-risk airway procedure. A multimodal bundle combining individualized propofol titration, proactive HFNO, enhanced respiratory surveillance, airway rescue readiness, and selected non-pharmacological adjuncts may improve procedural safety and patient experience.

KEYWORDS

class III obesity; gastrointestinal endoscopy; propofol; target-controlled infusion; high-flow nasal oxygen; virtual reality; procedural sedation; hypoxemia.

MAIN ARTICLE

INTRODUCTION

The increasing prevalence of obesity has resulted in a growing number of patients with class II and III obesity presenting for diagnostic and therapeutic gastrointestinal endoscopy.

Although esophagogastroduodenoscopy (EGD) is usually brief, sedation in severe obesity is not physiologically equivalent to routine sedation. Obesity reduces expiratory reserve volume and functional residual capacity, increases oxygen consumption and work of breathing, promotes dependent atelectasis, and increases the likelihood of upper-airway collapse. These changes accelerate desaturation when ventilation is impaired during sedation [1].

The upper gastrointestinal procedure itself adds a mechanical component: the endoscope and mouth guard share a vulnerable upper airway at the same time that propofol reduces pharyngeal dilator tone and ventilatory drive. Current British Society of Gastroenterology guidance therefore recommends pre-assessment and enhanced periprocedural monitoring in patients with obstructive sleep apnea and/or body mass index (BMI) ≥ 35 kg/m², and recommends capnography for deep propofol sedation [2].

High-flow nasal oxygen (HFNO) has emerged as a particularly attractive oxygenation strategy during deep sedation because it delivers a high and relatively stable inspired oxygen concentration, washes out nasopharyngeal dead space, and may generate a modest flow-dependent positive airway pressure while preserving oral access for the endoscopist [1,3-5].

In parallel, target-controlled infusion (TCI) permits progressive propofol titration, although conventional pharmacokinetic models have important limitations in severe obesity [6,7].

Immersive VR is an additional non-pharmacological intervention that may reduce anxiety and procedural distress, with emerging but heterogeneous evidence in gastrointestinal endoscopy [8-11].

We report the anesthetic management of a woman with class III obesity undergoing preoperative EGD before bariatric surgery, using a multimodal strategy that combined propofol TCI, proactive HFNO, and immersive VR. The aim is to use the case as a framework for a focused discussion of the major anesthetic challenges of sedation in severe obesity.

CASE PRESENTATION

A 35-year-old woman with class III obesity (BMI 46 kg/m²) was admitted for bariatric surgery and scheduled for preoperative EGD before sleeve gastrectomy. Her medical history included arterial hypertension treated with amlodipine. Routine laboratory investigations were reported as normal.

Because of the markedly elevated BMI and the expected reduction in respiratory reserve during upper endoscopy, the procedure was managed with an anesthesiologist-led sedation strategy and standard non-invasive cardiorespiratory monitoring. Airway rescue equipment was kept immediately available.

Sedation was provided with propofol delivered by TCI using the Marsh pharmacokinetic model. The infusion pump displayed a plasma target concentration of 3.0 µg/mL during the documented period of the procedure. The target concentration was used as a titration framework and adjusted according to the clinical depth of sedation and procedural tolerance rather than interpreted as an absolute pharmacodynamic endpoint.

Heated and humidified HFNO was instituted at a flow of 69 L/min, temperature 37°C, and FiO₂ 0.50. This allowed oxygen delivery to be maintained while the oral route remained available for insertion of the endoscope. An immersive VR headset was used as a complementary non-pharmacological distraction/anxiolytic intervention and remained in place during the procedure. The EGD was completed under the planned multimodal strategy.

DISCUSSION

The main anesthetic problem is not body size alone but the loss of respiratory reserve. Severe obesity is associated with reduced functional residual capacity and expiratory reserve volume, increased basal atelectasis, higher oxygen consumption, increased work of breathing, and reduced respiratory-system compliance. When apnea or marked hypoventilation occurs under sedation, the available oxygen reservoir is therefore smaller and desaturation develops more rapidly [1].

Upper-airway vulnerability is equally important. Obesity is associated with increased pharyngeal soft tissue and a higher prevalence of obstructive sleep apnea and obesity-

hypoventilation physiology. Propofol further reduces upper-airway dilator activity and ventilatory drive. During EGD, the endoscope partially occupies the same upper airway, so obstruction, central respiratory depression, and mechanical interference can coexist [1,2]. This is why a short diagnostic EGD in a patient with BMI 46 kg/m² should be approached as a high-risk respiratory procedure even when the patient is otherwise relatively young. The decision between monitored deep sedation and general anesthesia with tracheal intubation should therefore be individualized rather than based on BMI alone. Relevant factors include the predicted airway, suspected or established sleep apnea, aspiration risk, procedure duration and complexity, need for shared-airway access, and the ability of the local team to rescue the airway promptly [1,2]. In this case, a short preoperative EGD was managed without planned tracheal intubation but with proactive oxygenation and airway rescue readiness.

A central feature of this case was the decision to institute HFNO before the development of hypoxemia. This preventive approach is supported by randomized evidence. In the multicenter ODEPHI trial, high-risk patients undergoing gastrointestinal endoscopy under deep sedation received HFNO at 70 L/min with FiO₂ 0.50 or standard oxygen. HFNO reduced the incidence of SpO₂ ≤92% from 33.5% to 9.4% and reduced the need for airway-opening maneuvers from 32.4% to 11.1% [3]. The settings used in our patient—69 L/min and FiO₂ 0.50—are therefore almost identical to a regimen that has already been prospectively evaluated.

The obesity-specific evidence is even more compelling. In a 2025 multicenter randomized trial, 984 patients with obesity undergoing sedated gastrointestinal endoscopy were analyzed. HFNO reduced hypoxia from 21.2% with regular nasal cannula oxygenation to 2.0%, reduced subclinical respiratory depression from 36.3% to 5.6%, and reduced severe hypoxia from 4.1% to 0% [4]. These findings support using HFNO as a proactive rather than rescue strategy in selected patients with obesity.

Mechanistically, the benefit is plausibly multifactorial: a stable high inspired oxygen supply increases oxygen reserve; high flow reduces entrainment of room air; nasopharyngeal dead-space washout may improve ventilatory efficiency; and a modest positive pressure effect may partially counter upper-airway collapse. These effects are especially attractive when conventional face-mask oxygen is impractical because the mouth must remain accessible to the endoscopist [1,3].

An important safety message is that HFNO should not be confused with ventilation. In a 2026 randomized trial of 150 obese patients undergoing gastroscopy, HFNO at 50-70 L/min

reduced desaturation below 90% from 19% to 4% and reduced the need for airway interventions. However, apnea was detected more often in the HFNO group (23% vs 8%) [5]. This does not prove that HFNO causes clinically important apnea; rather, it highlights that oxygen saturation can remain acceptable despite persistent apnea or hypoventilation. This distinction is highly relevant in severe obesity. Pulse oximetry primarily reflects oxygenation, and high inspired oxygen can delay the fall in SpO₂ that would otherwise signal a ventilatory problem. Accordingly, HFNO must be combined with continuous clinical assessment of breathing and, for deep propofol sedation, guideline-supported ventilation monitoring such as capnography whenever technically feasible [2]. HFNO is an oxygenation strategy and a means of increasing the safety margin; it is not a substitute for airway vigilance, jaw-thrust capability, assisted ventilation, or readiness to secure the airway. Propofol is well suited to short gastrointestinal procedures because of its rapid onset and recovery profile, but dosing becomes less predictable as body composition departs from the populations used to build conventional pharmacokinetic models. TCI offers a practical advantage by allowing the clinician to set and progressively modify a target concentration rather than rely on repeated empirical boluses. Nevertheless, the displayed target is only as valid as the pharmacokinetic model behind it [6,7].

The Marsh model is simple and widely implemented, but body weight is its main size covariate and it does not incorporate allometric scaling. In morbid obesity, using total body weight can generate disproportionately large induction doses because central compartment volume does not increase linearly with total body weight. Reviews of current TCI practice therefore caution against interpreting Marsh targets uncritically at extremes of body weight [6].

The more recent Eleveld model uses a broader population dataset, allometric scaling, and fat-free-mass-related size descriptors. A 2025 systematic review found that Eleveld generally provides improved prediction of propofol clearance in obese patients, although no model is universally superior in every population [7]. Consequently, when Marsh is the available commercial model—as in the present case—the safest approach is conservative target setting, gradual titration, and continual assessment of clinical effect and ventilation. The photographed plasma target of 3.0 µg/mL should therefore be viewed as a documented point within a titration process rather than as a universally recommended concentration for patients with BMI 46 kg/m².

VR adds a different dimension to the sedation plan because it targets anxiety, attention, and perception rather than respiratory physiology. Randomized trials in upper endoscopy have

reported reductions in anxiety and improved comfort with VR in some settings, particularly when procedures are performed without systemic sedation [9-11]. A 2025 randomized colonoscopy trial also found lower propofol exposure in a VR-distraction strategy, although rescue intravenous sedation remained necessary in a substantial proportion of patients and comfort was better with conventional deep sedation [8].

These results justify describing VR as a promising complementary intervention, but not as a proven respiratory-sparing therapy. In our case there was no comparator arm and no validated anxiety score or prespecified propofol-sparing endpoint; therefore, no causal claim can be made that VR reduced propofol requirements. Furthermore, as sedation deepens and responsiveness decreases, the direct experiential effect of VR is likely to diminish. Its greatest theoretical value may therefore be before endoscope insertion and during lighter phases of sedation, when anxiety and anticipatory distress contribute most to sedative demand.

The principal value of the present case is the integration of complementary strategies rather than reliance on a single device. The respiratory problem of severe obesity was addressed with proactive HFNO and airway rescue readiness; hypnotic delivery was controlled with TCI and clinical titration; and the psychological component of procedural distress was addressed with VR. This can be conceptualized as a multimodal sedation bundle: psychological optimization, controlled hypnotic titration, proactive oxygenation, continuous respiratory surveillance, and immediate rescue capability.

This report describes a single patient and cannot establish superiority of the combined approach. The case was not designed to quantify the independent effects of HFNO, TCI, or VR, and the available case information does not provide a validated anxiety score, a comparator propofol regimen, or a prespecified ventilatory endpoint. Future prospective studies in patients with class III obesity should combine objective respiratory monitoring, standardized sedation-depth assessment, propofol consumption, patient-reported anxiety/comfort, and airway-intervention rates.

CONCLUSION

Class III obesity substantially increases the respiratory risk associated with propofol sedation for upper gastrointestinal endoscopy. The safest approach is not simply to treat desaturation when it occurs, but to anticipate the physiological sequence that leads to it. In the present case, a multimodal strategy combined propofol TCI, proactive HFNO at 69 L/min with FiO₂ 0.50, and immersive VR. The HFNO regimen is closely aligned with settings supported by randomized endoscopy trials, but improved oxygenation must not be equated with adequate

ventilation. Conventional Marsh pharmacokinetics also require cautious interpretation at extreme body weight. VR is best regarded as an adjunct for anxiety and distraction rather than a proven respiratory-protective intervention. For patients with severe obesity, multimodal sedation should always remain anchored in enhanced respiratory monitoring and immediate airway rescue capability.

FIGURE

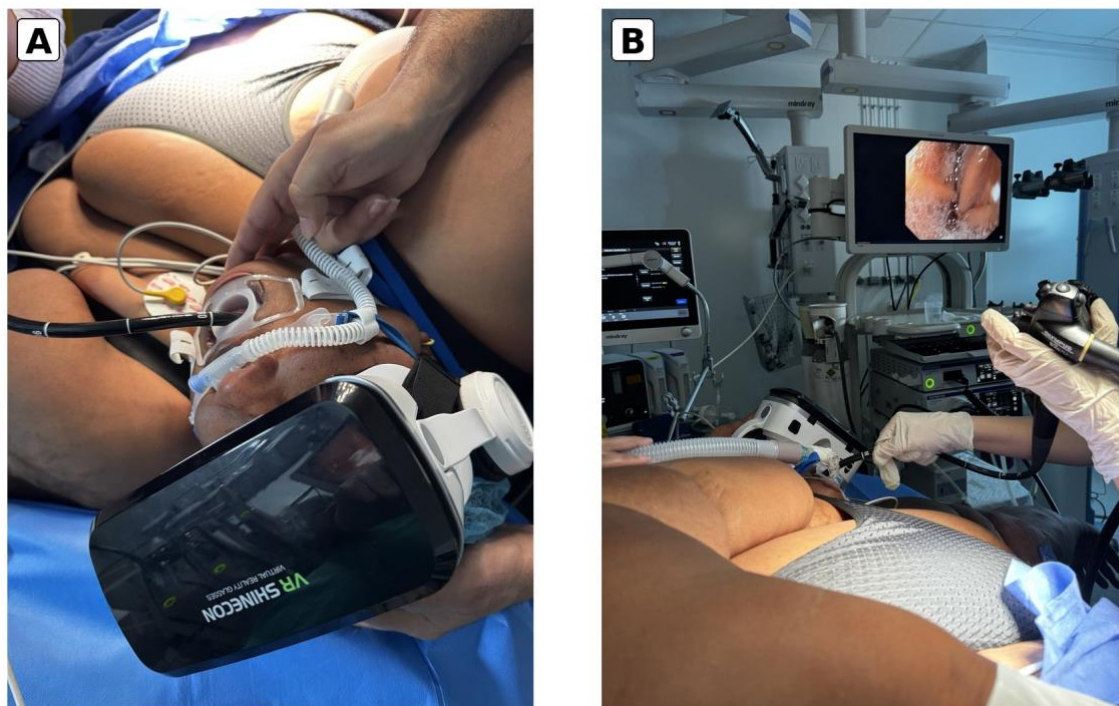


Figure 1. Multimodal sedation setup during preoperative upper gastrointestinal endoscopy. (A) Close-up showing the immersive VR headset, high-flow oxygen interface, mouth guard, and shared upper-airway environment. (B) EGD in progress while HFNO and the VR interface are maintained. The images illustrate the practical coexistence of oxygenation support, immersive distraction, and oral endoscopic access.



Figure 2. Propofol target-controlled infusion during the procedure. The infusion pump displays the Marsh pharmacokinetic model with a plasma target concentration of 3.0 µg/mL at the photographed time point. In severe obesity, this value should be interpreted as part of an individualized titration process rather than as a universally recommended target.

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