Cureus
Part of SPRINGER NATURE

Open Access Review Article

Perioperative Management of Glucagon-Like Peptide-1 (GLP-1) Receptor Agonists in Patients Undergoing Anesthesia: A Narrative Review of Gastric Emptying, Residual Gastric Contents, and Aspiration Risk

Humza Bari [1, 2], Ahmed Khan [3], Shane M. Abbasi [4]

1. Osteopathic Medicine, University of New England, Portland, USA 2. Medical Affairs, Hackensack Meridian Health, Red Bank, USA 3. Pulmonary and Critical Care Medicine, Ellis Hospital, Schenectady, USA 4. Medicine, University of New England, Portland, USA

Corresponding author: Humza Bari, hbari86@gmail.com

Review began 10/04/2026
Review ended 11/01/2026
Published 11/02/2026

© Copyright 2026
Bari et al. This is an open access article distributed under the terms of the Creative Commons Attribution License CC-BY 4.0., which permits unrestricted use, distribution, and reproduction in any medium, provided the original author and source are credited.

DOI: 10.7759/cureus.119012

Abstract

Glucagon-like peptide-1 (GLP-1) receptor agonists (GLP-1 RAs) improve glycemic control and promote weight loss partly by slowing gastric emptying, which has raised a real question in anesthesia practice: does standard preprocedural fasting reliably produce an empty stomach in these patients? This narrative review works through the physiological mechanism, the perioperative evidence, how guidance has changed over time, practical management strategies, and what remains unresolved.

Human physiology studies support a coordinated mechanism - inhibited antral propulsion, increased pyloric resistance, and vagally mediated gastric accommodation. The clinical effect varies considerably from patient to patient: some develop persistent delay in solid-phase emptying, while others show partial adaptation the longer they stay on treatment. Gastric ultrasound and endoscopy studies consistently find more residual gastric content among GLP-1 RA users who followed standard fasting, particularly during early treatment, dose escalation, or recent semaglutide use. The link to actual pulmonary aspiration, though, is considerably weaker. Case reports show aspiration can occur even after prolonged fasting and several days off the medication, but larger cohorts and meta-analyses generally find aspiration rates that are low in absolute terms and statistically uncertain.

As a result, guidance has shifted from routine cessation toward a more individualized approach: continuation with risk stratification, a 24-hour liquid diet for higher-risk patients, day-of symptom assessment, gastric ultrasound where available, and full-stomach precautions when uncertainty remains. The most defensible approach isn't a universal hold interval - it's an individualized assessment that weighs treatment phase, symptoms, formulation, procedure type, fasting quality, the metabolic cost of interrupting therapy, and, when feasible, direct assessment of gastric contents.

Categories: Family/General Practice, Internal Medicine, Gastroenterology
Keywords: ambulatory surgery, gastrointestinal motility, gastrointestinal surgery, glp-1 receptor agonist, monitored anesthesia care

Introduction And Background

Obesity and type 2 diabetes are among the most common chronic conditions worldwide. More than one billion people were living with obesity in 2022 [1], and an estimated 529 million people were living with diabetes in 2021 [2]. Both conditions are linked to cardiometabolic disease, so many of these patients present for surgery and endoscopy.

Glucagon-like peptide-1 (GLP-1) receptor agonists (RAs) include exenatide, lixisenatide, liraglutide, semaglutide, and dulaglutide. Tirzepatide is a dual GLP-1/glucose-dependent insulinotropic polypeptide (GIP) agonist. These drugs are now widely used for type 2 diabetes, obesity, and related cardiometabolic conditions. They lower glucose and reduce appetite, and they slow gastric emptying, which can affect how long food stays in the stomach [3,4]. Daily and weekly injectable formulations exist alongside oral semaglutide, so the clinically relevant differences go beyond the route of administration. Dosing interval, half-life, treatment phase, dose escalation, indication, and individual gastrointestinal response all matter (Table *1*) [5].

How to cite this article
Bari H, Khan A, Abbasi S M (November 02, 2026) Perioperative Management of Glucagon-Like Peptide-1 (GLP-1) Receptor Agonists in Patients Undergoing Anesthesia: A Narrative Review of Gastric Emptying, Residual Gastric Contents, and Aspiration Risk. Cureus 18(11): e119012. DOI 10.7759/cureus.119012

Agent	Class	Dosing interval	Approximate half-life	Main approved indications	Predominant effect on gastric emptying
Exenatide (twice daily)	GLP-1 RA	Twice daily	About 2.4 hours	Type 2 diabetes	Prominent slowing after each dose; little tachyphylaxis
Lixisenatide	GLP-1 RA	Once daily	About 3 hours	Type 2 diabetes	Prominent slowing after each dose; little tachyphylaxis
Liraglutide	GLP-1 RA	Once daily	About 13 hours	Type 2 diabetes; chronic weight management (higher dose)	Slowing present early; attenuates in some patients with continued use
Semaglutide, oral	GLP-1 RA	Once daily	About 1 week	Type 2 diabetes	Slowing may attenuate with continued use; variable between patients
Semaglutide, subcutaneous	GLP-1 RA	Once weekly	About 1 week	Type 2 diabetes; chronic weight management; cardiovascular risk reduction	Slowing may attenuate with continued use; variable between patients
Dulaglutide	GLP-1 RA	Once weekly	About 5 days	Type 2 diabetes; cardiovascular risk reduction	Slowing may attenuate with continued use; variable between patients
Exenatide (extended release)	GLP-1 RA	Once weekly	Release-limited; steady state after several weeks	Type 2 diabetes	Less gastric slowing than the twice-daily formulation
Tirzepatide	Dual GLP-1/GIP agonist	Once weekly	About 5 days	Type 2 diabetes; chronic weight management	Slowing may attenuate over time; variable between patients

TABLE 1: Pharmacokinetic and pharmacodynamic comparison of GLP-1-based agents

Half-lives are approximate values from product labeling [5]. GLP: Glucagon-like peptide-1; GIP: glucose-dependent insulinotropic polypeptide; RA: receptor agonist.

Daily liraglutide, for example, is pharmacokinetically distinct from weekly injectable semaglutide, dulaglutide, and tirzepatide. Oral semaglutide is taken daily, but its elimination half-life is about one week, similar to injectable semaglutide. It behaves as a long-acting agent, and drug levels build up over several weeks of treatment.

Delayed gastric emptying can leave solid food or a meaningful volume of liquid in the stomach despite fasting. Under deep sedation or general anesthesia, regurgitated material can enter the airway. For clarity, residual gastric content (RGC) here means solid material or an abnormally large volume of liquid in the stomach after a patient has fasted according to standard guidance. It is usually detected by gastric ultrasound or endoscopy. RGC is a surrogate marker of risk, not an aspiration event, and pulmonary aspiration itself is uncommon. In the largest comparative endoscopy cohort, aspiration occurred at roughly four per 1,000 procedures in both GLP-1 RA and comparator groups [6]. A recent meta-analysis of nine studies reported fewer than two aspiration cases per 1,000 patients overall [7]. This distinction explains why the literature can appear contradictory. Ultrasound and endoscopy studies tend to show more gastric content in GLP-1 RA users, while large outcome cohorts and meta-analyses have generally not found a statistically significant increase in pulmonary aspiration [6,7].

Professional guidance has changed quickly. The American Society of Anesthesiologists (ASA) issued consensus-based guidance in 2023 [8]. The American Gastroenterological Association (AGA) [9], a multisociety group [10], a UK multidisciplinary consensus [11], and Australian and New Zealand societies [12] have since moved toward individualized, risk-based approaches.

This review is organized around six questions. First, how do GLP-1-based drugs alter gastric motor function, and how consistent is that effect across patients? Second, what do case reports, ultrasound studies, and endoscopy cohorts show about residual gastric content after standard fasting? Third, does that signal translate into more aspiration or aspiration pneumonia? Fourth, how has guidance evolved from the ASA's 2023 hold recommendations toward the risk-based strategies used today? Fifth, how should clinicians manage treatment interruption, symptoms, diet, ultrasound, and anesthetic technique? Sixth, is a fixed

medication hold an adequate proxy for gastric safety, or should fasting quality and direct gastric assessment carry more weight?

Review

Methods

This is a structured narrative review. We followed the Scale for the Assessment of Narrative Review Articles (SANRA) checklist for narrative reviews [13]. We did not apply Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) 2020 [14] in full, because we did not pool data or perform a systematic synthesis. The search, eligibility criteria, and selection process are described below so that readers can judge the work and repeat it.

Search Strategy

We searched PubMed/MEDLINE and Google Scholar from database inception to 4 October 2026. The core PubMed query was: ("GLP-1 receptor agonist" OR semaglutide OR liraglutide OR dulaglutide OR exenatide OR lixisenatide OR tirzepatide) AND ("gastric emptying" OR "residual gastric content" OR "gastric volume" OR "pulmonary aspiration" OR aspiration OR perioperative OR anesthesia OR endoscopy OR "gastric ultrasound"). We also hand-searched the reference lists of major society guidance documents and recent systematic reviews to find additional primary studies and later commentary.

Eligibility

We included human studies and guidance documents that addressed gastric emptying, residual gastric content, or aspiration in people taking GLP-1 RAs or tirzepatide. Eligible designs were randomized trials, cohort, case-control, and cross-sectional studies, systematic reviews and meta-analyses, case reports and series, and society guidance. We excluded animal and preclinical studies, studies without gastric or aspiration outcomes, conference abstracts without full text, non-English publications, and opinion pieces that contained no data and were not guidance documents.

Selection and Appraisal

Records were screened first by title and abstract and then by full text, and disagreements were resolved by discussion among the authors. Because this was not a systematic review, we did not keep a formal record count. We did not apply a formal risk-of-bias tool. Instead, we appraised each study qualitatively for design, comparator, sample size, outcome definition (residual content versus clinical aspiration), and confounding. We gave more weight to randomized trials and systematic reviews for questions of effect, and to cohorts and case series for questions of mechanism and implementation. Where a meta-analysis reported a certainty-of-evidence rating, we report it. Guidance reflects the most recent version of each document at the time of writing.

Results

Gastric Motor Effects and Pharmacology

GLP-1 receptor activation inhibits antropyloroduodenal motility and slows gastric emptying [15]. Gastric accommodation and motor inhibition are partly mediated through vagal circuits [3,15]. Patients may have early satiety, nausea, reflux, dyspepsia, and vomiting alongside the delayed emptying itself, but these symptoms do not reliably show how much is in the stomach. The 2025 UK multidisciplinary consensus specifically cautioned against using upper gastrointestinal symptoms alone to decide whether the stomach is empty [11].

How emptying is measured affects the result. Scintigraphy with a radiolabeled solid meal is the reference standard for solid-phase emptying. Table *2* lists the studies behind the pooled estimates discussed here, which come from the meta-analysis by Hiramoto et al. [4].

Method	Study	Agent	Population	Design
Scintigraphy	Jensterle et al. [16]	Semaglutide (weekly)	Women with obesity and polycystic ovary syndrome	Randomized trial
Scintigraphy	Jones et al. [17]	Exenatide (once weekly)	Healthy, overweight adults at steady state	Randomized trial
Scintigraphy	Halawi et al. [18]	Liraglutide	Adults with obesity	Placebo-controlled pilot trial
Scintigraphy	Maselli et al. [19]	Liraglutide	Adults with obesity	Randomized clinical and pharmacogenomic trial
Scintigraphy	Acosta et al. [20]	Exenatide	Adults with obesity and accelerated gastric emptying	Randomized pharmacodynamic study
Acetaminophen absorption	Friedrichsen et al. [21]	Semaglutide 2.4 mg (weekly)	Adults with obesity	Randomized trial
Acetaminophen absorption	Dahl et al. [22]	Semaglutide (oral)	Type 2 diabetes	Randomized trial
Acetaminophen absorption	Becker et al. [23]	Lixisenatide	Healthy volunteers	Crossover trial
Scintigraphy and acetaminophen (Pooled results)	Hiramoto et al. [4]	-	-	Scintigraphy (5 studies, 247 participants): delay of 36.0 minutes (95% CI 17.0 to 55.0). Acetaminophen (10 studies, 411 participants): no significant delay in time to peak concentration or area under the curve

TABLE 2: Gastric emptying studies by measurement method

CI: confidence interval.

We did not repeat the pooling ourselves. That meta-analysis found that five scintigraphy studies (n=247) showed a pooled mean delay of 36 minutes with GLP-1 RA therapy. The five trials tested weekly semaglutide [16], once-weekly exenatide [17], liraglutide [18,19], and exenatide in people with accelerated emptying [20]. Ten studies that used the acetaminophen absorption test (n=411) found no significant delay in the pooled analysis [4]. Trials that used this test included weekly semaglutide in adults with obesity [21], oral semaglutide in type 2 diabetes [22], and lixisenatide in healthy volunteers [23]. Acetaminophen absorption reflects intestinal absorption more than gastric emptying specifically, and it tracks liquid more than solid transit. A normal result on that test therefore does not rule out clinically meaningful solid retention [4].

Clear liquids may leave the stomach reasonably efficiently while solids linger, particularly after a recent meal or early in treatment. A modest average delay does not mean that standard fasting is unsafe for every patient. What matters at the bedside is whether a specific patient has solid or high-volume content at induction.

Agents differ in formulation, duration, and dose. Short-acting agents (twice-daily exenatide, lixisenatide) and long-acting agents (liraglutide, semaglutide, dulaglutide, weekly exenatide, tirzepatide) do not produce identical exposure patterns. Their half-lives, indications, and predominant gastric effects are compared in Table *1*. Physiology studies describe gastric slowing as dose-dependent, and some slowing can persist after weeks of therapy even when partial adaptation occurs [4]. As noted above, oral semaglutide behaves pharmacokinetically like injectable semaglutide. A one-day hold under the ASA's daily-agent rule would therefore leave near-steady-state drug levels, which is a reason to treat the "daily" label with caution for this agent.

Tachyphylaxis occurs but is not dependable. Repeated exposure can blunt GLP-1-mediated gastric slowing, but the adaptation is incomplete and varies between patients. In a reanalysis of a randomized liraglutide

trial in people with obesity, a substantial proportion of participants had delayed solid emptying at five weeks, and some but not all had normalized by 16 weeks [24]. Longer treatment lowered the likelihood of delay in some patients without reliably eliminating it [24]. Clinicians should therefore treat dose escalation, recent re-initiation, symptoms, and known delayed emptying as risk modifiers, and should not rely on treatment duration alone as a safety certificate.

Residual Gastric Contents Despite Appropriate Fasting

Table 3 summarizes the key studies discussed below.

Study	Design and population	Main finding	Main limitation
Sherwin et al. [25]	Prospective observational ultrasound study; 20 adults without obesity, 8-hour fast	Solid content in 70% of semaglutide users versus 10% of controls (supine); 90% versus 20% (right lateral)	Small sample; recent initiators
Sen et al. [26]	Cross-sectional ultrasound study; 124 patients (62 on a weekly GLP-1 RA, 62 controls)	Increased residual gastric content in 56% versus 19%; adjusted prevalence difference 30.5% (95% CI 9.9% to 51.2%)	Single center; no aspiration outcomes
Shahidifar et al. [27]	Prospective point-of-care ultrasound study; GLP-1 RA users and 60 controls fasting 8 to 16 hours	Solid content in 5.4% (4 of 74) versus 5.0% (3 of 60); longer fasting showed non-significant trends toward less solid content and lower gastric volume; time since last dose not significant	Very few patients with solid content; associations not statistically significant
Silveira et al. [28]	Retrospective analysis of patients having elective upper endoscopy	More residual gastric content in semaglutide users	Retrospective
Kobori et al. [29]	Matched case-control; 205 GLP-1 RA users and 205 non-users with diabetes having EGD	Gastric residue in 5.4% versus 0.49%	Single center; few events
Ukwade et al. [30]	Retrospective EGD study	More retained gastric contents in GLP-1 RA users; same-day colonoscopy reduced this risk	Retrospective
Alkabbani et al. [6]	Cohort; 43,365 adults with type 2 diabetes having upper endoscopy (GLP-1 RA versus SGLT-2 inhibitor)	Aspiration 4.15 versus 4.26 per 1,000 (risk ratio 0.98, 95% CI 0.73 to 1.31); more discontinued procedures with GLP-1 RA (risk ratio 1.99, 95% CI 1.56 to 2.53)	Claims data; coded outcomes
Yeo et al. [31]	Population-based cohort; 963,184 endoscopy patients	Aspiration pneumonia 0.83% versus 0.63% (hazard ratio 1.33, 95% CI 1.02 to 1.74)	Coded outcome; residual confounding
Elkin et al. [7]	Systematic review and meta-analysis; 28 observational studies	Aspiration: OR 1.04 (95% CI 0.87 to 1.25; 9 studies). Residual gastric contents: OR 5.96 (95% CI 3.96 to 8.98; 18 studies). Skipping at least one dose: OR 0.51 (95% CI 0.33 to 0.81; 5 studies)	Low to very low certainty of evidence
OCULUS, Ahmad et al. [32]	Randomized single-masked trial; interim analysis of 60 patients having EGD, EUS, or ERCP	Clinically significant residual gastric volume 25.0% (continue) versus 3.1% (hold); stopped early; no aspiration events	Interim analysis; not powered for aspiration; planned general anesthesia excluded

TABLE 3: Key studies of residual gastric content and aspiration

Absolute differences were calculated from the reported percentages. CI: confidence interval; EGD: esophagogastroduodenoscopy; EUS: endoscopic ultrasound; ERCP: endoscopic retrograde cholangiopancreatography; OR: odds ratio; RA: receptor agonist; SGLT-2: sodium-glucose cotransporter-2.

The first warnings came from case reports of retained food, regurgitation, and aspiration in patients taking semaglutide who reported appropriate fasting. One widely cited report described a patient with obesity on semaglutide whose endoscopy was aborted because of retained food despite compliance with standard ASA fasting guidelines [33]. Another described verified pulmonary aspiration in a patient on semaglutide who had fasted for 18 hours, with delayed gastric emptying confirmed [34]. Case reports matter because they reveal failure modes. They cannot estimate incidence, and they cannot separate the drug effect from confounders such as diabetes, gastroparesis, reflux, procedure type, or anesthetic technique. The 2025

Australian and New Zealand guidance identified six published aspiration case reports and treated them as grounds for risk mitigation, not as proof that a universal hold was necessary [12].

A 2025 systematic review of aspiration during elective upper endoscopy included five case reports involving six patients, of whom some aspirated [35]. Hold durations and fasting times varied, and several patients had held the drug for fewer than seven days. These reports therefore do not test whether a complete, ASA-concordant hold is protective. They show that aspiration can still occur after fasting and after a shortened or partial hold. They are few and heterogeneous, and they are prone to publication bias.

The strongest early signal came from gastric ultrasound. In a prospective observational study of 20 adults without obesity who had recently started semaglutide, all participants fasted for eight hours [25]. Solid content was visible in 70% of semaglutide users versus 10% of controls in the supine position, and in 90% versus 20% in the right lateral position. Two hours after drinking about 350 mL of water, the groups still differed on supine assessment [25]. The study was small and enrolled recent initiators, so it may not apply to patients on stable long-term treatment.

A larger cross-sectional study enrolled 124 patients who had followed standard fasting instructions before elective procedures under anesthesia, 62 on a weekly GLP-1 RA and 62 controls [26]. Increased residual gastric content was found in 56% of users versus 19% of controls. After adjustment, the prevalence difference was 30.5% (95% CI 9.9% to 51.2%) [26]. Most perioperative ultrasound and cohort evidence concerns weekly injectable agents, particularly semaglutide [25,26], so it may not carry over to other agents or routes of administration.

Studies disagree on whether dose timing or fasting duration matters more. A 2025 prospective ultrasound study compared 74 weekly GLP-1 RA users with 60 controls who fasted for between 8 and 16 hours. Solid gastric content was similarly uncommon in both groups, at 5.4% (four of 74) versus 5.0% (three of 60). Users with solid content had shorter fasting times, and fasting duration showed a stronger inverse association with gastric volume than time since the last dose. These associations were trends and did not reach statistical significance [27]. The result differs from the larger study by Sen et al. [26] and Sherwin et al. [25], probably because the populations, treatment histories, fasting windows, ultrasound definitions, and selection criteria were not the same. The finding is hypothesis-generating at best. It rests on a single study with very few patients who had solid content and non-significant associations, and it does not show that longer fasting eliminates risk or justify fasting beyond standard guidance.

Endoscopy studies point the same way as the ultrasound work. A retrospective analysis of patients undergoing elective upper endoscopy found more residual gastric content in semaglutide users [28]. In a matched case-control study of 410 patients with diabetes undergoing endoscopy, gastric residue was found in 5.4% of GLP-1 RA users (11 of 205) and 0.49% of matched non-users (one of 205) [29]. A 2025 retrospective study of upper endoscopy also found more retained gastric contents in GLP-1 RA users and reported that same-day colonoscopy reduced this risk [30]. These studies were observational and mostly single-center, with few events.

Aspiration Outcomes and Clinical Relevance

Pulmonary aspiration is rare, and it is not the same thing as residual content. Residual gastric content is a necessary precondition for aspiration but not a sufficient one. Aspiration also depends on whether regurgitation occurs, airway reflexes, airway protection, patient positioning, depth of anesthesia, suction availability, use of rapid-sequence technique, and the procedure itself. The 2025 UK consensus noted that even appropriately fasted elective patients can have gastric content or volumes associated with elevated aspiration risk [11]. This is why ultrasound and endoscopy studies can show large relative differences in residual content without a clearly detectable rise in aspiration events. A drug can raise how often a patient needs a modified plan, a delayed procedure, or extra suction without measurably raising the rare outcome of aspiration pneumonia.

Retrospective cohorts show conflicting but low absolute risks. In the largest comparative endoscopy cohort, aspiration was no more frequent with GLP-1 RAs than with SGLT-2 inhibitors, although endoscopies were discontinued about twice as often. This fits with more retained content being found, and not with more aspiration [6]. A population-based cohort found a modestly higher rate of coded aspiration pneumonia among users [31]. That may be a real signal, but it is vulnerable to residual confounding, because users may differ in diabetes severity, obesity, reflux, comorbidity burden, procedure complexity, and anesthesia exposure. It also measured a coded diagnosis, not observed aspiration [31]. Taken together, these cohorts support a cautious middle-ground conclusion. GLP-1 RA use is clearly linked to more retained content and procedural disruption, but a clear increase in aspiration has not been established (Table *3*).

A 2025 meta-analysis of 28 observational studies found no significant association with aspiration, but a strong association with residual gastric contents despite appropriate fasting. Skipping at least one dose was associated with lower odds of residual contents. Certainty of evidence was low to very low [7]. An earlier systematic review of GLP-1 RAs in patients undergoing anesthesia or sedation addressed the same question

[36].

For randomized evidence, the OCULUS trial assigned adults on a stable GLP-1 or GLP-1/GIP agonist, scheduled for elective upper endoscopy, endoscopic ultrasound (EUS), or ERCP (endoscopic retrograde cholangiopancreatography), to continue the drug or hold it (seven to 13 days for weekly agents, at least one day for daily agents). A prespecified interim analysis of 60 patients found clinically significant residual gastric volume much less often with a hold than with continuation, and the trial stopped early. Most patients with significant residual volume had no symptoms on the day, and no aspiration occurred. The trial was not powered for rare safety events, did not assess glycemic consequences, and excluded planned general anesthesia [32].

A low aspiration rate does not necessarily mean the signal is harmless, and the outcome data are less reassuring than they first appear. In endoscopy, retained food is usually seen and suctioned, or the procedure is aborted, before aspiration can occur. This is the likely source of the higher discontinuation rate in the large cohort [6]. Clinicians who know a patient takes a GLP-1 RA may also already be using rapid-sequence induction, extended liquid diets, or added precautions. In such settings, the absence of excess aspiration shows that current precautions work. It does not show that residual content is harmless. The outcome data are therefore best read as reassurance about current practice, not about unmitigated risk. Figure *1* summarizes how the evidence links delayed gastric emptying, residual content, and aspiration.

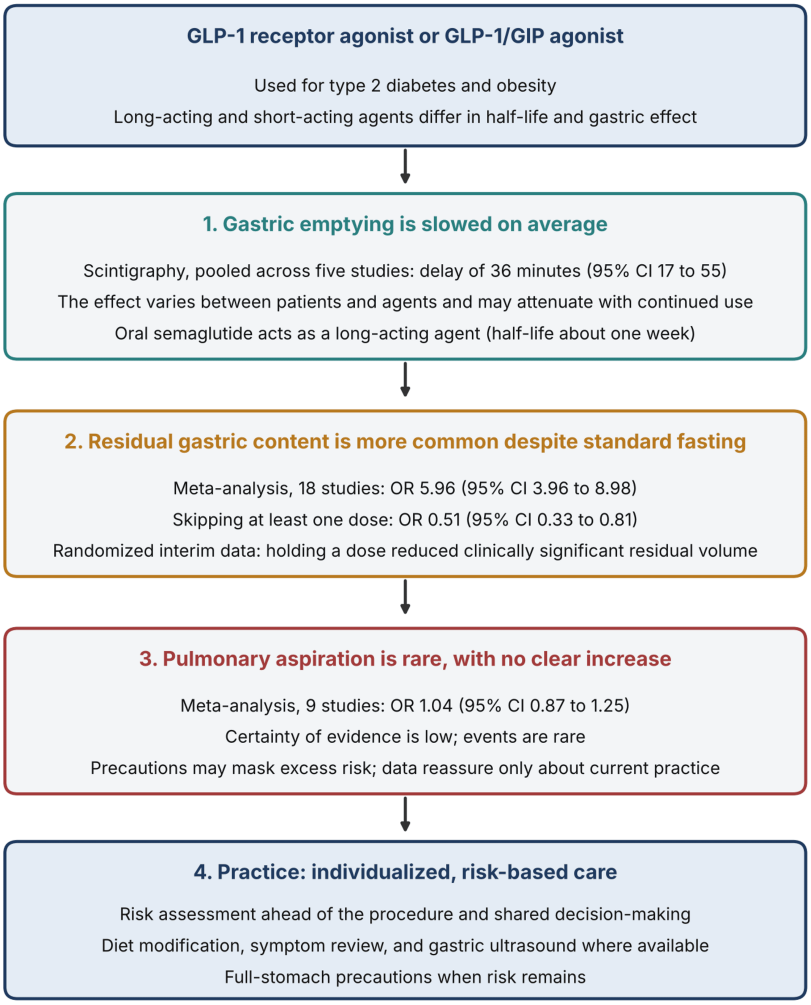


FIGURE 1: Summary of the evidence from gastric emptying to aspiration in patients taking GLP-1-based agents

CI: confidence interval; GLP-1: glucagon-like peptide-1; GIP: glucose-dependent insulinotropic polypeptide; OR: odds ratio.

Evolution of Guidance: From Fixed Holds to Risk-Based Strategies

Table 4 compares the major guidelines.

Source	Region	Medication	Dietary advice	Day-of-procedure assessment	Stated basis
ASA consensus-based guidance, 2023 [8]	United States	Hold daily agents on the day of the procedure; hold weekly agents one week before	Not specified as a diet protocol	Delay elective procedures if symptoms of delayed emptying; otherwise proceed with full-stomach precautions or consider gastric ultrasound	Consensus-based
AGA rapid clinical practice update, 2024 [9]	United States	Individualize; no data support stopping in all patients; withholding for weight loss alone may be reasonable but not mandatory	Liquid diet the day before is an alternative to stopping	Proceed if standard fasting completed and no symptoms; consider rapid-sequence intubation if symptomatic	Expert panel
Multisociety guidance, 2024 [10]	United States and international	Shared decision; usually continue when risk is not elevated; if held, follow ASA intervals	Liquid diet for at least 24 hours when symptom review raises concern	Symptom review; gastric ultrasound where available; weigh rapid-sequence induction against cancellation	Guidance, not an evidence-based guideline
UK multidisciplinary consensus, 2025 [11]	United Kingdom	Continue throughout the perioperative period	24-hour clear-liquid diet	Do not rely on upper gastrointestinal symptoms alone; consider gastric ultrasound	Multidisciplinary consensus
ADS/ANZCA/GESA/NACOS recommendations, 2025 [12]	Australia and New Zealand	Continue	24-hour clear-fluid diet	Risk-based reassessment on the day	Clinical practice recommendations
SPAQI multidisciplinary consensus, 2025 [37]	United States-led, with AACE	Continue in asymptomatic patients to preserve glycemic and cardiovascular benefit; stopping long-acting agents for less than four to five weeks may not fully restore normal gastric emptying	Solids about 24 hours before anesthesia; clear liquids about 4 to 8 hours depending on caloric content; standard ASA fasting insufficient	Symptom-based and risk-based assessment	Multidisciplinary consensus

TABLE 4: Comparison of society guidance on perioperative GLP-1 RA management

AACE: American Association of Clinical Endocrinology; ADS: Australian Diabetes Society; AGA: American Gastroenterological Association; ANZCA: Australian and New Zealand College of Anaesthetists; ASA: American Society of Anesthesiologists; GESA: Gastroenterological Society of Australia; NACOS: National Association of Clinical Obesity Services; SPAQI: Society for Perioperative Assessment and Quality Improvement.

The ASA advised in 2023 that daily agents be held on the day of the procedure and weekly agents one week before. It advised delaying elective procedures for patients with symptoms of delayed emptying, and proceeding with full-stomach precautions or considering gastric ultrasound for asymptomatic patients who had not held the drug [8]. This guidance was consensus-based and not derived from clearance-period data.

The AGA's 2024 update concluded that there were no data supporting stopping GLP-1 RAs in all patients. It advised individualized management, noted that withholding for weight loss alone may be reasonable but should not be considered mandatory or evidence-based, and said patients who completed standard fasting and had no symptoms could proceed. A liquid diet the day before was offered as an alternative to stopping, and rapid-sequence intubation could be considered for symptomatic patients, although this may not be feasible in ambulatory settings [9]. The 2024 multisociety guidance emphasized shared decision-making and identified factors that raise risk: the escalation phase, higher doses, weekly formulations, gastrointestinal symptoms, and conditions such as gastroparesis or Parkinson's disease. It cautioned that holding carries costs, including hyperglycemia, and that withholding a drug only because a patient has obesity could reflect weight bias. If a hold is chosen, it suggested following the ASA intervals and acknowledged that the optimal

duration is unknown. It also described a liquid diet of at least 24 hours when symptom review raises concern. Its authors stated that it was guidance and not an evidence-based guideline [10].

In 2025 the UK and the Australian and New Zealand documents moved further. The UK multidisciplinary consensus recommended continuing GLP-1 RAs throughout the perioperative period, discussing aspiration risk with patients, and considering gastric ultrasound before induction. It recommended a 24-hour clear-liquid diet for patients on these agents and was explicit that upper gastrointestinal symptoms alone should not determine gastric content [11]. The Australian and New Zealand recommendations, developed jointly by the Australian Diabetes Society, the Gastroenterological Society of Australia, the National Association of Clinical Obesity Services, and the Australian and New Zealand College of Anaesthetists, were more prescriptive about diet. They advised continuing the drugs and using a 24-hour clear-fluid diet [12].

The 2025 consensus came from the Society for Perioperative Assessment and Quality Improvement (SPAQI), working with the American Association of Clinical Endocrinology (AACE) [37]. It favored continuing GLP-1 RAs in asymptomatic patients to preserve glycemic and cardiovascular benefit. It also advised that standard ASA fasting intervals may be insufficient for these patients, suggesting a longer fast for solids (about 24 hours) and a shorter clear-liquid fast (about four to eight hours, depending on caloric content). It noted that stopping long-acting agents for less than four to five weeks may not fully restore normal gastric emptying [37]. That last point bears directly on the ASA's one-week interval, and it supports the argument here that a fixed hold is an imperfect proxy for an empty stomach.

Across documents, the direction of travel is consistent. Fixed hold intervals have become one option among several. None of the documents claims that the ASA intervals are evidence-based clearance periods, and the first randomized data (OCULUS) only now provide a test of holding [32].

Perioperative Management in Practice

Holding a GLP-1 RA is not free of cost. It can cause hyperglycemia in patients with diabetes, may require bridging therapy, and can interrupt weight management [10]. The decision should be shared between the anesthesia, procedural, and prescribing teams and the patient. Holding may be reasonable for a patient with elevated risk and a low glycemic penalty. For patients who continue, the other layers of protection below apply.

Symptom review is useful but incomplete. Nausea, vomiting, dyspepsia, distension, and constipation raise concern, but the UK consensus cautioned against relying on symptoms alone [11], and in the OCULUS interim analysis most patients with significant residual volume had no symptoms [32]. A symptomatic patient should be treated as higher risk. An asymptomatic patient is not necessarily safe.

Guidance on how far to depart from standard fasting is not uniform. The UK, Australian and New Zealand, and multisociety documents support a clear-liquid diet for about 24 hours in patients judged at risk [10-12], and the SPAQI consensus goes further with a longer solid fast [37]. The evidence that longer fasting reduces residual content is limited and inconsistent [27]. Prolonged fasting also has risks, including dehydration, hypoglycemia in patients on insulin or sulfonylureas, and ketosis with SGLT-2 inhibitor co-therapy. Any extended fast or liquid diet should therefore be individualized, with a glycemic plan, and patients should be counseled to follow the instructions precisely.

Point-of-care ultrasound can identify solid content or a high fluid volume before induction. Several documents recommend it as an option [8,10,11]. Availability, operator skill, and credentialing limit its use, and a normal examination does not eliminate risk [10].

When retained contents are suspected or confirmed, the team can delay an elective procedure or proceed with rapid-sequence induction and airway precautions. The choice should be made by shared decision-making [9,10]. Rapid-sequence techniques may not be practical in some ambulatory and office-based settings [9].

A Risk-Stratified Clinical Approach

Figure *2* summarizes a practical pathway based on the guidance above.

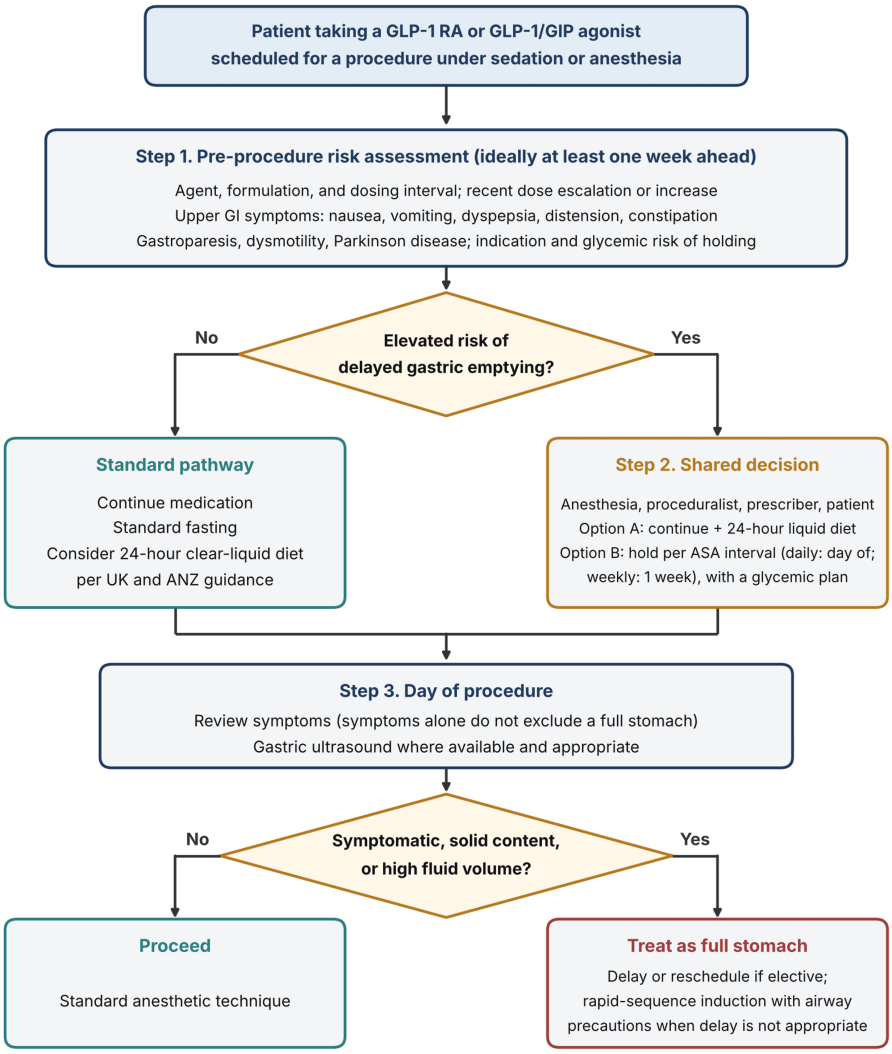


FIGURE 2: Risk-stratified approach to patients taking GLP-1 receptor agonists before procedures under sedation or anesthesia

ASA: American Society of Anesthesiologists; GLP: glucagon-like peptide-1; GIP: glucose-dependent insulinotropic polypeptide; RA: receptor agonist.

It draws mainly on the ASA, AGA, multisociety, UK, and Australian and New Zealand documents [8-12]. The SPAQI consensus differs mainly in its fasting intervals [37]. The pathway has three steps. First, assess risk ahead of the procedure, ideally at least a week before, using the agent and formulation, recent dose escalation, gastrointestinal symptoms, conditions that slow gastric emptying, and the glycemic risk of holding. Second, for patients at elevated risk, agree on a plan in a shared decision: continue with a 24-hour liquid diet, or hold using the ASA intervals together with a glycemic plan. Third, on the day of the procedure, review symptoms and use gastric ultrasound where available. Patients with symptoms, solid content, or a high fluid volume are treated as having a full stomach. That means delay when the case is elective, and rapid-sequence induction with airway precautions when delay is not appropriate. The pathway is a synthesis of published guidance, not a validated protocol.

Is a fixed hold an adequate proxy for gastric safety? Based on the current evidence, it is an imperfect one. Hold intervals were set by consensus, residual content has been reported after partial holds, and the first randomized data suggest that holding reduces residual volume without telling us what happens to aspiration. Fasting quality, diet, and direct assessment of gastric contents appear to add information that a calendar interval alone cannot.

Limitations

This review has several limitations. It is a narrative review, so the search was not exhaustive, and selection

and appraisal were qualitative. Relevant studies, particularly in non-English literature, may have been missed. Much of the evidence is observational and affected by confounding, and many studies are small, single-center, or retrospective. Residual gastric content, the most consistent finding, is a surrogate outcome, and pulmonary aspiration is too rare for most studies to detect small differences. The main randomized trial is an interim analysis of 60 patients. Most data concern weekly injectable semaglutide, so findings may not apply to other agents, to tirzepatide, or to patients on long-term stable therapy. Guidance is evolving quickly, and documents published after 4 October 2026 are not reflected. The proposed pathway has not been prospectively validated.

Conclusions

GLP-1-based drugs delay gastric emptying on average, but the effect varies between patients, agents, and treatment phases. Residual gastric content after standard fasting is more common in users, and the first randomized data suggest that holding a dose reduces it. Pulmonary aspiration remains rare, and current evidence has not shown a clear increase, although the outcome data are limited by low event rates and existing precautions. Guidance has moved from fixed hold intervals toward individualized, risk-based care that combines risk assessment, shared decision-making, diet, gastric ultrasound, and full-stomach precautions when risk remains. No single strategy has been proven best, and prospective studies that measure aspiration and glycemic outcomes are needed.

Additional Information

Author Contributions

All authors have reviewed the final version to be published and agreed to be accountable for all aspects of the work.

Concept and design: Humza Bari, Ahmed Khan, Shane M. Abbasi

Acquisition, analysis, or interpretation of data: Humza Bari, Ahmed Khan, Shane M. Abbasi

Drafting of the manuscript: Humza Bari, Ahmed Khan, Shane M. Abbasi

Critical review of the manuscript for important intellectual content: Humza Bari, Ahmed Khan, Shane M. Abbasi

Supervision: Humza Bari, Ahmed Khan, Shane M. Abbasi

Disclosures

Conflicts of interest: In compliance with the ICMJE uniform disclosure form, all authors declare the following: **Payment/services info:** All authors have declared that no financial support was received from any organization for the submitted work. **Financial relationships:** All authors have declared that they have no financial relationships at present or within the previous three years with any organizations that might have an interest in the submitted work. **Other relationships:** All authors have declared that there are no other relationships or activities that could appear to have influenced the submitted work.

References

1. Phelps NH, Singleton RK, Zhou B, et al.: Worldwide trends in underweight and obesity from 1990 to 2022: a pooled analysis of 3663 population-representative studies with 222 million children, adolescents, and adults. Lancet. 2024, 403:1027-50. 10.1016/S0140-6736(23)02750-2
2. Ong KL, Stafford LK, McLaughlin SA, et al.: Global, regional, and national burden of diabetes from 1990 to 2021, with projections of prevalence to 2050: a systematic analysis for the Global Burden of Disease Study 2021. Lancet. 2023, 402:203-34. 10.1016/S0140-6736(23)01301-6
3. Camilleri M, Acosta A: Newer pharmacological interventions directed at gut hormones for obesity . Br J Pharmacol. 2024, 181:1153-64. 10.1111/bph.16278
4. Hiramoto B, McCarty TR, Lodhia NA, et al.: Quantified metrics of gastric emptying delay by glucagon-like peptide-1 agonists: A systematic review and meta-analysis with insights for periprocedural management. Am J Gastroenterol. 2024, 119:1126-40. 10.14309/ajg.0000000000002820
5. Lim EC, Lim CE: Perioperative management of GLP-1 receptor agonists: balancing aspiration risk with therapeutic benefit. SN Compr Clin Med. 2025, 7:313. 10.1007/s42399-025-02079-9
6. Alkabbani W, Suissa K, Gu KD, et al.: Glucagon-like peptide-1 receptor agonists before upper gastrointestinal endoscopy and risk of pulmonary aspiration or discontinuation of procedure: cohort study. BMJ. 2024, 387:e080340. 10.1136/bmj-2024-080340
7. Elkin J, Rele S, Sumithran P, et al.: Association between glucagon-like peptide-1 receptor agonist use and peri-operative pulmonary aspiration: a systematic review and meta-analysis. Anaesthesia. 2025, 80:846-58. 10.1111/anae.16601
8. American Society of Anesthesiologists Consensus-Based Guidance on Preoperative Management of Patients (Adults and Children) on Glucagon-Like Peptide-1 (GLP-1) Receptor Agonists. (2023). Accessed: September 15, 2026: https://www.asahq.org/about-asa/newsroom/news-releases/2023/06/american-society-of-

anesthesiologists-consensus-based-....
9. Hashash JG, Thompson CC, Wang AY: AGA rapid clinical practice update on the management of patients taking GLP-1 receptor agonists prior to endoscopy: communication. Clin Gastroenterol Hepatol. 2024, 22:705-7. 10.1016/j.cgh.2023.11.002
10. Joshi GP, LaMasters T, Kindel TL: Preprocedure care of patients on GLP-1 receptor agonists: a multisociety clinical practice guidance. Anesthesiology. 2024, 141:1208-9. 10.1097/ALN.0000000000005231
11. El-Boghdadly K, Dhesi J, Fabb P, et al.: Elective peri-operative management of adults taking glucagon-like peptide-1 receptor agonists, glucose-dependent insulinotropic peptide agonists and sodium-glucose cotransporter-2 inhibitors: a multidisciplinary consensus statement. Anaesthesia. 2025, 80:412-24. 10.1111/anae.16541
12. Hocking SL, Scott DA, Remedios ML, et al.: 2025 ADS/ANZCA/GESA/NACOS clinical practice recommendations on the peri-procedural use of GLP-1/GIP receptor agonists. Anaesth Intensive Care. 2025, 53:300-6. 10.1177/0310057X251355288
13. Baethge C, Goldbeck-Wood S, Mertens S: SANRA-a scale for the quality assessment of narrative review articles. Res Integr Peer Rev. 2019, 4:5. 10.1186/s41073-019-0064-8
14. Page MJ, McKenzie JE, Bossuyt PM, et al.: The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. BMJ. 2021, 372:n71. 10.1136/bmj.n71
15. Schirra J, Houck P, Wank U, Arnold R, Göke B, Katschinski M: Effects of glucagon-like peptide-1(7-36)amide on antro-pyloro-duodenal motility in the interdigestive state and with duodenal lipid perfusion in humans. Gut. 2000, 46:622-31. 10.1136/gut.46.5.622
16. Jensterle M, Ferjan S, Ležaič L, Sočan A, Goričar K, Zaletel K, Janez A: Semaglutide delays 4-hour gastric emptying in women with polycystic ovary syndrome and obesity. Diabetes Obes Metab. 2023, 25:975-84. 10.1111/dom.14944
17. Jones KL, Huynh LQ, Hatzinikolas S, et al.: Exenatide once weekly slows gastric emptying of solids and liquids in healthy, overweight people at steady-state concentrations. Diabetes Obes Metab. 2020, 22:788-97. 10.1111/dom.13956
18. Halawi H, Khemani D, Eckert D, et al.: Effects of liraglutide on weight, satiation, and gastric functions in obesity: a randomised, placebo-controlled pilot trial. Lancet Gastroenterol Hepatol. 2017, 2:890-9. 10.1016/S2468-1253(17)30285-6
19. Maselli D, Atieh J, Clark MM, et al.: Effects of liraglutide on gastrointestinal functions and weight in obesity: a randomized clinical and pharmacogenomic trial. Obesity (Silver Spring). 2022, 30:1608-20. 10.1002/oby.23481
20. Acosta A, Camilleri M, Burton D, O'Neill J, Eckert D, Carlson P, Zinsmeister AR: Exenatide in obesity with accelerated gastric emptying: a randomized, pharmacodynamics study. Physiol Rep. 2015, 3:e12610. 10.14814/phy2.12610
21. Friedrichsen M, Breitschaft A, Tadayon S, Wizert A, Skovgaard D: The effect of semaglutide 2.4 mg once weekly on energy intake, appetite, control of eating, and gastric emptying in adults with obesity. Diabetes Obes Metab. 2021, 23:754-62. 10.1111/dom.14280
22. Dahl K, Brooks A, Almazedi F, Hoff ST, Boschini C, Baekdal TA: Oral semaglutide improves postprandial glucose and lipid metabolism, and delays gastric emptying, in subjects with type 2 diabetes. Diabetes Obes Metab. 2021, 23:1594-603. 10.1111/dom.14373
23. Becker RH, Stechl J, Steinstraesser A, Golor G, Pellissier F: Lixisenatide reduces postprandial hyperglycaemia via gastrostatic and insulinotropic effects. Diabetes Metab Res Rev. 2015, 31:610-8. 10.1002/dmrr.2647
24. Camilleri M, Carlson P, Dilmaghani S: Prevalence and variations in gastric emptying delay in response to GLP-1 receptor agonist liraglutide. Obesity (Silver Spring). 2024, 32:232-3. 10.1002/oby.23941
25. Sherwin M, Hamburger J, Katz D, DeMaria S Jr: Influence of semaglutide use on the presence of residual gastric solids on gastric ultrasound: a prospective observational study in volunteers without obesity recently started on semaglutide. Can J Anaesth. 2023, 70:1300-6. 10.1007/s12630-023-02549-5
26. Sen S, Potnuru PP, Hernandez N, Goehl C, Praestholm C, Sridhar S, Nwokolo OO: Glucagon-like peptide-1 receptor agonist use and residual gastric content before anesthesia. JAMA Surg. 2024, 159:660-7. 10.1001/jamasurg.2024.0111
27. Shahidifar E, Lesniowska M, Deschenes E, et al.: Fasting duration, not timing of last GLP-1 dose, predicts aspiration risk indicators: a prospective point-of-care gastric ultrasound study. Dig Dis Sci. 2026, 71:1926-36. 10.1007/s10620-025-09570-2
28. Silveira SQ, da Silva LM, de Campos Vieira Abib A, et al.: Relationship between perioperative semaglutide use and residual gastric content: a retrospective analysis of patients undergoing elective upper endoscopy. J Clin Anesth. 2023, 87:111091. 10.1016/j.jclinane.2023.111091
29. Kobori T, Onishi Y, Yoshida Y, et al.: Association of glucagon-like peptide-1 receptor agonist treatment with gastric residue in an esophagogastroduodenoscopy. J Diabetes Investig. 2023, 14:767-73. 10.1111/jdi.14005
30. Ukwade D, Hernandez LJ, Modi Z, et al.: GLP-1 receptor agonist increase retained gastric contents on EGD and same-day colonoscopy reduces this risk. Front Med (Lausanne). 2025, 12:1638981. 10.3389/fmed.2025.1638981
31. Yeo YH, Gaddam S, Ng WH, Huang PC, Ma KS, Rezaie A: Increased risk of aspiration pneumonia associated with endoscopic procedures among patients with glucagon-like peptide 1 receptor agonist use. Gastroenterology. 2024, 167:402-4.e3. 10.1053/j.gastro.2024.03.015
32. Ahmad AI, Garg S, Jacobs J, et al.: Holding vs continuing GLP-1/GIP agonists before upper endoscopy: the OCULUS randomized clinical trial. JAMA Intern Med. 2026, 186:578-84. 10.1001/jamainternmed.2026.0027
33. Fujino E, Cobb KW, Schoenherr J, Gouker L, Lund E: Anesthesia considerations for a patient on semaglutide and delayed gastric emptying. Cureus. 2023, 15:e42153. 10.7759/cureus.42153
34. Klein SR, Hobai IA: Semaglutide, delayed gastric emptying, and intraoperative pulmonary aspiration: a case report. Can J Anaesth. 2023, 70:1394-6. 10.1007/s12630-023-02440-3
35. Elmati PR, Jagirdhar GS, Qasba RK, et al.: GLP-1 agonists and the risk of pulmonary aspiration during

elective upper endoscopy: a systematic review and meta-analysis. Open Respir Med J. 2025, 19:e18743064372550. 10.2174/0118743064372550250603061720

36. do Nascimento TS, Pereira RO, Maia E, et al.: The impact of glucagon-like peptide-1 receptor agonists in the patients undergoing anesthesia or sedation: systematic review and meta-analysis. Perioper Med (Lond). 2024, 13:78. 10.1186/s13741-024-00439-y
37. Oprea AD, Ostapenko LJ, Sweitzer B, et al.: Perioperative management of patients taking glucagon-like peptide 1 receptor agonists: Society for Perioperative Assessment and Quality Improvement (SPAQI) multidisciplinary consensus statement. Br J Anaesth. 2025, 135:48-78. 10.1016/j.bja.2025.04.001