

Review

Integration and Combination of GLP-1/GIP Therapies, Bariatric Endoscopy, and Metabolic Surgery in the Treatment of Obesity: A Scoping Review

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Abstract

Background: The development of glucagon-like peptide-1 receptor agonists (GLP-1 Ras or GLP-1) and dual glucagon-like peptide-1/glucose-dependent insulintropic polypeptide (GLP-1/GIP) receptor agonists has expanded the therapeutic options for multimodal obesity management. However, evidence regarding the integration, combination, or sequencing of these therapies with bariatric/metabolic endoscopy and bariatric/metabolic surgery has not been comprehensively synthesized. **Methods:** A scoping review was conducted following the methodological framework of Arksey and Levac, the recommendations of the Joanna Briggs Institute, and the PRISMA-ScR guidelines. A systematic search was performed in PubMed, Scopus, and Embase from database inception through 16 May 2026. Studies involving adults that evaluated GLP-1/GIP agonists in relation to endoscopic and/or surgical bariatric/metabolic procedures were included. Data extraction was independently performed by two reviewers, and the evidence was synthesized using descriptive and narrative analyses. **Results:** All 14 studies directly evaluated strategies involving the integration, combination, or sequencing of pharmacotherapy with bariatric/metabolic endoscopy and/or bariatric/metabolic surgery and therefore contributed to the primary synthesis. The reported sample sizes across the 14 included studies summed to approximately 6401 participants, with individual study sample sizes ranging from 40 to 4901 patients. Most were retrospective cohort studies (10/14; 71.4%), followed by randomized controlled trials or prospective studies (3/14; 21.4%) and comparative observational studies. GLP-1 were the most frequently evaluated pharmacological agents, particularly semaglutide (7/14; 50.0%) and liraglutide (6/14; 42.9%), whereas tirzepatide was investigated in two studies (2/14; 14.3%). Endoscopic interventions were evaluated in 11 of the 14 included studies (78.6%). The most frequently evaluated endoscopic intervention was the intra-gastric balloon (IGB) (4/14; 28.6%), followed by transoral outlet reduction (TORe) (1/14; 7.1%), endoscopic sleeve gastropasty (ESG) (1/14; 7.1%), revisional ESG (R-ESG) (1/14; 7.1%), and other revisional endoscopic procedures. **Conclusions:** Evidence regarding integrated, combined, sequential, adjuvant, or comparative treatment strategies for obesity management remains limited and is predominantly derived from observational studies. The integration of pharmacotherapy with endoscopic and surgical interventions shows promising results; however, high-quality prospective studies and randomized clinical trials are needed to define the optimal treatment sequence and identify the patients most likely to benefit from these multimodal approaches.



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Keywords: obesity; GLP-1 receptor agonists; bariatric endoscopy; metabolic surgery; multimodal therapy

1. Introduction

Obesity is a chronic low-grade inflammatory disease characterized by adipose tissue dysfunction, insulin resistance, and metabolic disturbances, representing one of the greatest global public health challenges [1,2]. According to the World Health Organization (WHO) and the NCD Risk Factor Collaboration (NCD-RisC), more than one billion people worldwide are currently living with obesity [2–4]. In 2022, the global prevalence of obesity among adults was estimated at 16%, and obesity is associated with a substantially increased risk of type 2 diabetes mellitus, cardiovascular disease, obstructive sleep apnea, metabolic dysfunction-associated steatotic liver disease, several types of cancer, and premature mortality [4–6]. Consequently, obesity requires sustainable long-term therapeutic strategies [7–9]. Bariatric and metabolic surgery is currently the most effective treatment for obesity compared with lifestyle interventions or pharmacological therapy alone [9,10].

Procedures such as laparoscopic sleeve gastrectomy (LSG) and Roux-en-Y gastric bypass (RYGB) provide durable weight loss and substantial metabolic benefits [11–13]. Meanwhile, endoscopic techniques, including the intragastric balloon and endoscopic sleeve gastropasty, have emerged as less invasive alternatives that are frequently used as bridge or rescue therapies, although they often require adjunctive strategies to optimize and maintain treatment outcomes [10–13]. More recently, the introduction of incretin-based pharmacotherapies has transformed the contemporary management of obesity. Glucagon-like peptide-1 receptor agonists (GLP-1Ras or GLP-1), such as liraglutide and semaglutide, as well as dual GLP-1/glucose-dependent insulinotropic polypeptide (GIP) receptor agonists, such as tirzepatide, have demonstrated unprecedented efficacy in reducing body weight while improving cardiometabolic outcomes [14,15].

The availability of incretin-based pharmacotherapy, advanced bariatric endoscopic techniques, and well-established surgical procedures has fostered a multimodal approach to obesity management [11–14]. These strategies integrate, combine, or sequence pharmacological, endoscopic, and surgical interventions at different stages of treatment to maximize weight loss, reduce weight regain, and personalize care according to individual patient response [10–15]. Most published studies have focused on the use of GLP-1/GIP agonists before or after bariatric surgery, whereas relatively few have evaluated the integration of pharmacotherapy, bariatric endoscopy, and surgery within a single therapeutic pathway [11–16]. Therefore, the aim of this scoping review was to identify and map the available evidence on strategies integrating, combining, or sequencing GLP-1/GIP-based pharmacotherapy, bariatric/metabolic endoscopy, and bariatric/metabolic surgery in adults with obesity.

2. Methods

2.1. Study Design

A scoping review was conducted in May 2026 to address the following research question: What evidence exists regarding the integration, combination, or sequencing of GLP-1/GIP-based pharmacotherapy, bariatric/metabolic endoscopy, and bariatric/metabolic surgery in the management of adults with obesity?

To ensure methodological rigor and reproducibility, the review followed the methodological frameworks proposed by Arksey and Levac [17,18], complemented by the recommendations of the Joanna Briggs Institute (JBI) for scoping reviews [19]. Reporting

was conducted in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses Extension for Scoping Reviews (PRISMA-ScR) statement [20] (Supplementary Table S1). The review followed the sequential stages of identifying the research question, identifying relevant studies, study selection, data charting, and collating, summarizing, and reporting the results.

2.2. Identification of Relevant Studies

A comprehensive literature search was conducted in PubMed, Scopus, and Embase. The search strategy combined controlled vocabulary (MeSH and Emtree terms) with free-text keywords related to obesity, GLP-1 receptor agonists, dual GLP-1/GIP receptor agonists, anti-obesity pharmacotherapy, bariatric/metabolic surgery, bariatric/metabolic endoscopy, combination therapy, and sequential or perioperative treatment approaches. Boolean operators (“AND” and “OR”) were used to combine search terms. The complete search strategies for each database are provided in Supplementary Table S2. Studies published from database inception through 16 May 2026 were considered for inclusion.

2.3. Eligibility Criteria

Eligibility criteria were established according to the Population–Concept–Context (PCC) framework recommended by the Joanna Briggs Institute. The population comprised adults (≥ 18 years) with obesity undergoing pharmacological, endoscopic, and/or surgical treatment for obesity management. Studies involving pediatric populations, animal models, or indications unrelated to obesity were excluded.

The concept included studies evaluating GLP-1 receptor agonists or dual GLP-1/GIP receptor agonists at any stage of the obesity treatment continuum, including their use before or after bariatric or metabolic procedures. Emphasis was placed on studies assessing strategies involving the integration, combination, or sequencing of pharmacotherapy, bariatric/metabolic endoscopy, and bariatric/metabolic surgery. Endoscopic interventions were defined as bariatric or metabolic procedures performed using an endoscopic approach, including primary procedures such as intragastric balloon and endoscopic sleeve gastropasty, as well as revisional procedures performed after previous bariatric surgery. Revisional endoscopic procedures were defined as endoscopic interventions intended to modify postoperative anatomy or address inadequate weight loss or weight regain after bariatric surgery, including transoral outlet reduction, revisional endoscopic sleeve gastropasty, and other endoscopic revision procedures when the specific technique was not further specified by the original study.

For the purposes of study eligibility and evidence synthesis, therapeutic strategies were operationally defined according to the relationship between pharmacotherapy and endoscopic or surgical treatment. Integrated strategies were defined as treatment pathways in which pharmacotherapy and an endoscopic and/or surgical intervention were intentionally incorporated into an overall obesity-management plan, with the therapeutic role of each modality explicitly described. Combined strategies were defined as the concurrent use of pharmacotherapy and endoscopic and/or surgical intervention as components of the same treatment episode or therapeutic regimen. Sequential strategies were defined as the planned or clinically intended use of pharmacotherapy and an endoscopic and/or surgical intervention at different time points, with one modality preceding or following the other as part of the treatment pathway. Studies evaluating pharmacotherapy and endoscopic or surgical intervention as alternative treatment pathways were additionally considered when the study directly compared these modalities within the same clinical context, even when the same patients did not receive both interventions.

A study was considered to directly evaluate an integrated, combined, sequential, or comparative treatment strategy when it met the following minimum criteria: (1) included adults with obesity receiving or being evaluated for obesity treatment; (2) evaluated a GLP-1 receptor agonist, dual GLP-1/GIP receptor agonist, or other eligible anti-obesity pharmacotherapy in relation to a bariatric/metabolic endoscopic or surgical intervention; (3) explicitly described the therapeutic relationship between pharmacotherapy and the procedure, including concurrent administration, planned sequencing, adjuvant use, post-procedural treatment, or direct comparison of the treatment modalities; and (4) reported at least one clinical outcome relevant to obesity treatment, such as weight loss, weight regain, metabolic outcomes, or treatment-related adverse events. Studies in which pharmacotherapy and procedural treatment were mentioned only as background treatments, without evaluating their therapeutic relationship or comparative role, were not considered to directly evaluate an integrated or multimodal strategy.

The context encompassed clinical, hospital, surgical, endoscopic, and specialized obesity management settings. Eligible study designs included randomized controlled trials, cohort studies, case-control studies, comparative observational studies, and case series. Reviews, editorials, letters to the editor, expert opinions, conference abstracts without full-text publications, and studies lacking original data were excluded.

2.4. Study Selection

All retrieved records were imported into Rayyan for duplicate removal and study screening [21]. Study selection was performed in three stages: duplicate removal, title and abstract screening, and full-text review. Title/abstract screening and full-text assessment were independently conducted by three reviewers according to the predefined eligibility criteria. Disagreements were resolved through discussion and, when necessary, consultation with a fourth reviewer. The study selection process is summarized in a PRISMA flow diagram [20].

2.5. Data Extraction and Evidence Synthesis

Extracted variables included author, year of publication, country, study design, sample size, population characteristics, type of pharmacotherapy, type of endoscopic intervention, type of bariatric/metabolic surgery, therapeutic strategy evaluated, timing of pharmacotherapy relative to the endoscopic or surgical intervention, and the clinical purpose of pharmacotherapy [22]. The latter was categorized as preprocedural weight-loss therapy, bridge therapy to a planned endoscopic or surgical intervention, concomitant therapy, treatment of inadequate response after a procedure, or treatment of weight regain after a procedure. Weight loss outcomes, metabolic outcomes, adverse events, and follow-up duration were also extracted. Given the exploratory nature of this review, the evidence was synthesized using descriptive and narrative approaches. Timing and clinical purpose were assessed separately to distinguish the temporal relationship of pharmacotherapy to the procedure from its intended role in the treatment pathway. Preprocedural weight-loss therapy was defined as pharmacotherapy administered before an endoscopic or surgical intervention with the aim of achieving weight reduction or optimizing the patient before the procedure. Bridge therapy was defined as temporary pharmacological treatment intended to facilitate or enable a subsequent endoscopic or surgical intervention. Concomitant therapy referred to pharmacotherapy administered concurrently with an endoscopic or surgical intervention as part of a combined treatment strategy. Treatment of inadequate response referred to pharmacotherapy initiated after an endoscopic or surgical procedure because the initial weight-loss response was considered insufficient, whereas treatment of weight regain referred to pharmacotherapy initiated after previously achieved weight

loss was followed by clinically relevant weight regain. When a study reported sequential strategies involving more than one of these purposes, each phase of treatment was classified separately according to the reported clinical rationale.

All eligible studies evaluating GLP-1/GIP-based pharmacotherapy in relation to endoscopic or surgical procedures for obesity treatment were included in the scoping review. Studies were subsequently characterized according to the degree of therapeutic integration, timing, and clinical purpose of pharmacotherapy. The primary synthesis included studies directly evaluating the therapeutic relationship between pharmacotherapy and bariatric/metabolic endoscopy and/or surgery, including integrated, combined, sequential, adjuvant, and comparative treatment strategies.

Attention was given to studies directly evaluating strategies involving the integration, combination, or sequencing of pharmacotherapy with bariatric/metabolic endoscopy and/or bariatric/metabolic surgery. These strategies were further characterized according to the clinical purpose of pharmacotherapy, including preprocedural weight loss, bridge therapy to a planned procedure, concomitant treatment, management of inadequate response, and treatment of weight regain. Sequential treatment approaches, pharmacotherapy used in conjunction with revisional or conversional procedures, and comparative evaluations of multimodal treatment pathways were also considered. The remaining studies were used to contextualize the available evidence regarding the perioperative use of GLP-1/GIP agonists and other anti-obesity medications throughout the obesity treatment continuum. The evidence synthesis was organized into three main categories: (1) pharmacotherapy in relation to bariatric/metabolic surgery, including adjuvant and comparative strategies; (2) pharmacotherapy combined with bariatric/metabolic endoscopy; and (3) multimodal strategies integrating or sequencing pharmacotherapy, endoscopy, and surgery. Within these categories, therapeutic strategies were further described according to the timing and clinical purpose of pharmacotherapy. In addition, temporal publication trends, predominant methodological designs, evaluated interventions, and the main knowledge gaps identified across the literature were summarized.

3. Results

A total of 14 studies were included in the scoping review [23–36] (Figure 1). All 14 studies directly evaluated strategies involving the integration, combination, or sequencing of pharmacotherapy with bariatric/metabolic endoscopy and/or bariatric/metabolic surgery and therefore contributed to the primary synthesis. No additional studies were included solely for contextualization. The reported sample sizes across the 14 included studies summed to approximately 6401 participants, with individual study sample sizes ranging from 40 to 4901 patients. This figure represents the aggregate sample size across studies and should not be interpreted as the number of unique individual participants. Most were retrospective cohort studies (8/14; 57.1%) [23–27,30,32,33], followed by randomized controlled trials (3/14; 21.4%) [34–36], a prospective cohort study (1/14; 7.1%) [31], and comparative or matched observational studies (2/14; 14.3%) [28,29]. GLP-1 receptor agonists were the most frequently evaluated pharmacological agents, particularly semaglutide (7/14; 50.0%) [23–25,28,32–34] and liraglutide (6/14; 42.9%) [27,29–31,35,36], whereas tirzepatide was investigated in two studies (2/14; 14.3%) [25,32] (Tables 1 and 2). These categories were not considered mutually exclusive; a single study could be assigned to more than one category when its treatment pathway included multiple therapeutic phases or purposes.

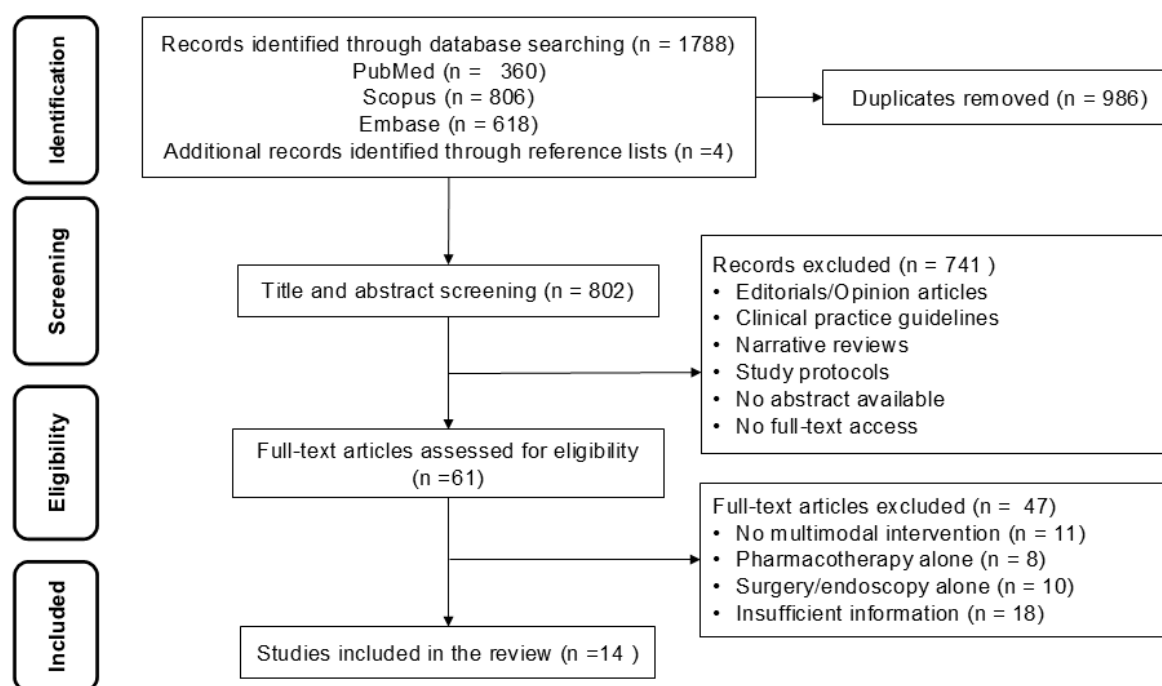


Figure 1. PRISMA Flow Diagram.

Table 1. Observational studies evaluating integration, combination, or sequencing strategies involving pharmacotherapy, bariatric/metabolic endoscopy, and bariatric/metabolic surgery.

Author/Year/ Country	Study Design	Population (n)	Pharmacological Intervention	Endoscopic Intervention	Metabolic Surgery	Therapeutic Strategy	Timing	Main Findings	Follow-up
Li et al. [23], 2026, China	Retrospective cohort	99 patients with obesity un- dergoing LSG	SEMA	BTX-A	LSG	Adjuvant phar- macotherapy to surgery	Postoperative	SEMA showed a trend toward greater %TWL and %EWL than BTX-A.	2 and 6 months
Teke et al. [24], 2026, Türkiye	Retrospective cohort	107 patients	SEMA	IGB	No	Sequential/ bridge therapy	Preoperative	IGB followed by SEMA achieved greater %TWL than IGB or SEMA alone.	12 months
Bahdi et al. [25], 2025, USA	Retrospective cohort	90 patients with weight regain after SG	SEMA or TZP	R-ESG	Previous SG	Adjuvant phar- macotherapy to surgery	Postoperative	R-ESG was superior in the short term; TZP achieved outcomes comparable to R-ESG at 12 months.	3, 6, and 12 months
Medhati et al. [26], 2025, USA	Retrospective cohort	400 patients	AOM	Endoscopic revision	Previous SG, RYGB, or AGB	Combined pharmacologic- endoscopic therapy	Postoperative	Endoscopic revision plus AOM achieved greater %TWL than revision or AOM alone.	19–29 months
Martines et al. [27], 2023, Italy	Retrospective cohort	86 patients	LIRA	IGB	LSG	Sequential/ bridge therapy	Preoperative	IGB followed by LSG was superior to LIRA followed by LSG in pre- and postoperative %EWL.	24 weeks + 12 months
Agrawal et al. [28], 2023, India	Comparative study	60 patients	SEMA	IGB	Planned bariatric surgery	Combined pharmacologic- endoscopic therapy	Preoperative	IGB plus SEMA achieved greater %TWL than IGB alone.	4 months
Badurdeen et al. [29], 2021, Brazil	Matched cohort	52 patients	LIRA	ESG	No	Combined pharmacologic- endoscopic therapy	Postoperative	ESG plus LIRA was superior to ESG alone.	12 months
Mosli & Elyas [30], 2017, Saudi Arabia	Retrospective cohort	108 patients	LIRA	IGB	No	Combined pharmacologic- endoscopic therapy	Postoperative	Greater initial weight loss with IGB plus LIRA, but no sustained long-term benefit.	12 months

Table 1. Cont.

Author/Year/ Country	Study Design	Population (n)	Pharmacological Intervention	Endoscopic Interven- tion	Metabolic Surgery	Therapeutic Strategy	Timing	Main Findings	Follow-up
Horber & Steffen [31], 2021, Switzerland	Prospective cohort	95 patients	LIRA	Endoscopic revision	Revisional RYGB	Adjuvant pharmacotherapy to surgery	Postoperative	LIRA demonstrated efficacy comparable to revisional surgery with fewer complications.	24 months
Brown et al. [32], 2025, USA	Retrospective cohort	4901 patients	SEMA or TZP	None	Conversional RYGB (cRYGB)	Pharmacotherapy vs. revisional surgery	Postoperative	cRYGB was superior to GLP-1RA therapy for long-term weight loss.	3 years
Wasden et al. [33], 2025, USA	Retrospective cohort	174 patients	SEMA	None	Conversional RYGB (cRYGB)	Pharmacotherapy vs. revisional surgery	Postoperative	cRYGB was superior overall; semaglutide responders achieved comparable outcomes.	2 years

Notes: AGB, adjustable gastric banding; AOM, anti-obesity medications; BTX-A, botulinum toxin type A; cRYGB, conversional Roux-en-Y gastric bypass; ECA, randomized controlled trial (RCT); ESG, endoscopic sleeve gastroplasty; %EWL, percentage of excess weight loss; GLP-1RA, glucagon-like peptide-1 receptor agonist; IGB, intragastric balloon; LIRA, liraglutide; LSG, laparoscopic sleeve gastrectomy; POSTOP, postoperative; PREOP, preoperative; R-ESG, revisional endoscopic sleeve gastroplasty; RP, weight regain; RYGB, Roux-en-Y gastric bypass; SEMA, semaglutide; SG, sleeve gastrectomy; TORe, transoral outlet reduction; %TWL, percentage of total weight loss; TZP, tirzepatide.

Table 2. Randomized controlled trials evaluating integration, combination, or sequencing strategies involving pharmacotherapy, bariatric/metabolic endoscopy, and bariatric/metabolic surgery.

Author/Year/ Country	Study Design	Population (n)	Pharmacological Intervention	Endoscopic Interven- tion	Metabolic Surgery	Therapeutic Strategy	Timing	Main Findings	Follow-up
Barakat et al. [34], 2025, Egypt/USA	Randomized prospective study	40 patients	SEMA	IGB	No	Combined pharmacologic-endoscopic therapy	Preoperative	IGB plus SEMA was associated with greater weight loss and a more favorable post-balloon weight trajectory.	3, 6, and 12 months
Lahooti et al. [35], 2025, Brazil	Randomized crossover trial	109 patients with weight regain after RYGB	LIRA	TORe	Previous RYGB	Combined pharmacologic-endoscopic therapy	Postoperative	LIRA enhanced and maintained the effect of TORe for up to 24 months.	24 months
Hany et al. [36], 2024, Egypt	Double-blind randomized controlled trial	80 patients	LIRA	None	SG conversion to RYGB	Adjuvant pharmacotherapy to surgery	Postoperative	LIRA improved weight loss following revisional surgery.	12 months

Notes: SEMA, semaglutide; LIRA, liraglutide; IGB, intragastric balloon; TORe, transoral outlet reduction; RYGB, Roux-en-Y gastric bypass; SG, sleeve gastrectomy.

Endoscopic interventions were evaluated in 11 of the 14 included studies (78.6%). The most frequently evaluated endoscopic intervention was the intragastric balloon (IGB) (5/14; 35.7%) [24,27,28,30,34], followed by transoral outlet reduction (TORe) (1/14; 7.1%) [35], endoscopic sleeve gastroplasty (ESG) (1/14; 7.1%) [29], revisional ESG (R-ESG) (1/14; 7.1%) [25], and other revisional endoscopic procedures (2/14; 14.3%) [26,31]. The latter included endoscopic revision procedures performed after previous bariatric surgery. The remaining three studies (3/14; 21.4%) evaluated pharmacotherapy in relation to surgical interventions without an endoscopic component. Bariatric or metabolic surgery was incorporated in 9 of the 14 studies (64.3%) [23,25,27,31–33,36], most commonly LSG or RYGB. Regarding therapeutic strategies, six studies (42.9%) evaluated combined pharmacologic-endoscopic interventions [26,28–30,34,35], four (28.6%) assessed adjuvant pharmacotherapy following primary or revisional bariatric surgery [23,25,31,36], two (14.3%) compared pharmacotherapy with revisional surgery [32,33], and two (14.3%) investigated sequential

treatment strategies or bridge therapies [24,27]. Most studies were conducted in the post-operative setting (10/14; 71.4%) [23,25,26,29–33,35,36], whereas four (28.6%) evaluated preoperative interventions [24,27,28,34]. Follow-up duration ranged from 4 months to 3 years.

Among studies evaluating combined pharmacologic-endoscopic strategies (6/14; 42.9%), the addition of GLP-1 receptor agonists to intragastric balloon therapy, ESG, or TORe consistently resulted in greater weight loss than endoscopic interventions alone [26,28–30,34,35]. Studies by Barakat, Agrawal, Badurdeen, and Lahooti demonstrated that adjunctive treatment with semaglutide or liraglutide enhanced and prolonged the weight-loss effects of endoscopic procedures [28,29,34,35]. Barakat et al. [34] reported that, after IGB removal, the IGB-only group experienced a mean weight increase of 2.79 ± 1.74 kg, whereas the IGB plus semaglutide group continued to lose weight, with a mean change of -3.94 ± 2.16 kg (between-group difference, 6.69 kg; $p < 0.001$). Thus, the combined strategy was associated with a more favorable post-removal weight trajectory than IGB alone. In contrast, Mosli and Elyas observed that these benefits may diminish following intragastric balloon removal [30].

Sequential treatment strategies and bridge therapies (2/14; 14.3%) also demonstrated favorable outcomes. Teke et al. reported that a sequential approach consisting of intragastric balloon placement followed by semaglutide achieved greater weight loss than either intervention alone [24]. Similarly, Martinez et al. evaluated liraglutide and intragastric balloon therapy as bridge interventions before sleeve gastrectomy, reporting greater preoperative weight loss in patients treated with the intragastric balloon [27]. Among patients experiencing weight regain after bariatric surgery, adjunctive pharmacotherapy and revisional procedures emerged as effective rescue strategies. Bahdi et al. found that both revisional ESG and GLP-1 receptor agonists achieved clinically meaningful weight loss following sleeve gastrectomy [25].

The two studies comparing pharmacotherapy with revisional surgery (14.3%) favored conversion to surgical procedures. Brown and Wasden reported greater weight loss following conversion to Roux-en-Y gastric bypass than with GLP-1 receptor agonist therapy [32,33]. However, a subgroup of patients who responded well to semaglutide achieved weight-loss outcomes comparable to those observed after revisional surgery [33].

Overall, the available evidence remains dominated by observational studies (11/14; 78.6%), with relatively few randomized controlled trials (3/14; 21.4%) and substantial heterogeneity in study populations, interventions, and reported outcomes. Notably, only 14 of the 61 included studies (23.0%) directly evaluated the therapeutic relationship between pharmacotherapy and bariatric/metabolic endoscopy and/or surgery, underscoring the limited evidence addressing integrated, combined, sequential, adjuvant, or comparative treatment strategies within the obesity treatment continuum [23–36].

4. Discussion

This scoping review mapped the available evidence on strategies integrating, combining, or sequencing incretin-based pharmacotherapy with bariatric/metabolic endoscopy and bariatric/metabolic surgery. Overall, the findings support the potential benefits of multimodal treatment approaches [23–36]. Combined pharmacologic-endoscopic interventions were the most frequently investigated strategy and generally achieved greater weight loss than endoscopic procedures alone [26,28–30,34,35]. Sequential approaches, particularly intragastric balloon therapy followed by semaglutide, were associated with greater weight reduction than either intervention used alone, suggesting a potential additive benefit [23–36]. In the postoperative setting, the addition of GLP-1 receptor agonists or other anti-obesity medications to surgical or endoscopic revisional procedures was associated with more

favorable weight-loss outcomes than isolated interventions [23,25,26,29–31,35,36]. Finally, when pharmacotherapy was directly compared with revisional surgery, conversional surgical procedures generally achieved greater weight loss [32,33], although a subgroup of patients who responded to semaglutide attained outcomes comparable to those achieved with revisional surgery [33].

Historically, pharmacotherapy, bariatric endoscopy, and bariatric surgery have been evaluated as independent treatment modalities [37–39]. However, emerging evidence suggests that obesity should be managed as a chronic disease requiring adaptive, longitudinal, and stepwise interventions rather than isolated therapeutic episodes [38,40]. This paradigm is consistent with recent recommendations from international scientific societies, which advocate personalized treatment strategies based on disease progression, clinical response, and individual patient characteristics [39,40]. Within this framework, GLP-1 receptor agonists and dual GLP-1/GIP receptor agonists have substantially expanded the therapeutic landscape by enabling their use before surgery as bridge therapy, after bariatric procedures to manage inadequate weight loss or weight regain, and in combination with endoscopic interventions to enhance and sustain weight-loss outcomes [37,38,40].

The integrated, combined, sequential, adjuvant, or comparative treatment strategies identified in this review were highly heterogeneous. In the preoperative setting, combining semaglutide with intragastric balloon therapy was associated with greater weight loss than IGB alone [34], while sequential or bridge strategies involving intragastric balloon or liraglutide were evaluated in patients undergoing subsequent bariatric surgery [24,27]. These findings suggest that pharmacotherapy and endoscopic interventions may have a potential role in preoperative weight optimization; however, the available evidence does not allow definitive conclusions regarding reduction in operative risk.

Several studies demonstrated that adding liraglutide or semaglutide after bariatric surgery, TORe, ESG, or revisional procedures resulted in additional weight loss [23,25,26,29–31,34–36]. From a pathophysiological perspective, these findings are biologically plausible because weight regain following bariatric procedures is multifactorial, involving neurohormonal adaptations, compensatory increases in appetite, and behavioral factors that may be partially counteracted by GLP-1 receptor agonists or dual GLP-1/GIP receptor agonists [37–40]. Likewise, the observation that sequential treatment with an intragastric balloon followed by semaglutide was associated with greater weight loss than either modality alone [24] suggests that sequential approaches may represent a potential strategy for continued weight management, although the available evidence remains limited.

Brown et al. and Wasden et al. reported greater weight loss following conversion to Roux-en-Y gastric bypass than with GLP-1 receptor agonist therapy [32,33]. Nevertheless, the finding that a subgroup of patients receiving semaglutide achieved weight-loss outcomes comparable to those observed after revisional surgery [33] highlights the potential importance of individualized treatment selection. In this context, pharmacotherapy may represent a less invasive alternative before considering rescue surgery, reserving revisional procedures for patients with inadequate response or treatment failure [38,39]. Such a stepwise strategy aligns with the emerging concept of precision medicine in obesity, whereby therapeutic decisions are tailored according to each patient's clinical profile, metabolic characteristics, and disease trajectory [41,42].

Despite these promising findings, the available evidence remains dominated by observational studies, primarily retrospective cohorts [23–33], with relatively few randomized controlled or prospective studies [34–36]. Furthermore, substantial heterogeneity exists regarding patient populations, interventions, treatment timing, and reported outcomes. Notably, only a small proportion of the studies identified in this review explicitly evaluated integrated, combined, or sequential strategies involving pharmacotherapy, endoscopy,

and surgery [23–36], whereas most of the literature continues to focus on the isolated perioperative use of GLP-1 receptor agonists before or after bariatric procedures. Future research should prioritize well-designed prospective comparative studies and randomized controlled trials that systematically evaluate multimodal treatment pathways across the entire obesity care continuum [23–36].

5. Limitations

This scoping review has several limitations. First, the considerable heterogeneity in study designs, patient populations, interventions, treatment sequences, and outcome measures limited direct comparisons across studies and precluded definitive conclusions regarding comparative effectiveness. Second, most included studies were retrospective cohorts, which are susceptible to selection bias, confounding, and information bias; therefore, observed differences in treatment outcomes or sequencing should not be interpreted as causal or as evidence of superiority unless supported by comparative evidence. Third, consistent with the objectives and methodology of a scoping review, no formal assessment of methodological quality or risk of bias was performed; accordingly, the findings should be interpreted cautiously and primarily as a mapping of the available evidence rather than as an estimate of treatment efficacy.

The literature search was limited to three electronic databases, and restricting inclusion to studies published in the selected languages and databases may have resulted in the omission of relevant evidence. Finally, the descriptive nature of scoping review methodology precluded quantitative estimation of pooled treatment effects and limits the ability to establish causal relationships between therapeutic strategies and outcomes.

6. Conclusions

Combined pharmacologic-endoscopic interventions were the most frequently evaluated integrated, combined, sequential, adjuvant, or comparative treatment strategies and generally achieved greater weight loss than endoscopic procedures alone. In the postoperative setting, the addition of GLP-1 or other anti-obesity medications to revisional surgical or endoscopic procedures was associated with improved outcomes compared with isolated interventions. However, the evidence supporting combined pharmacologic-endoscopic strategies is more extensive than that involving pharmacotherapy in conjunction with revisional surgery. Overall, evidence for integrated pharmacologic and procedural approaches to obesity management remains limited and predominantly observational, particularly for strategies involving revisional surgery.

Supplementary Materials: The following supporting information can be downloaded at: <https://www.mdpi.com/article/10.3390/gidisord8040060/s1>, Table S1. PRISMA Extension for Scoping Reviews (PRISMA-ScR) 2018 Checklist [20]; Table S2: Search Strategies.

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