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(REVIEW ARTICLE)

Surgical versus medical treatment of obesity in the New Era: A systematic review

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Abstract

Background: Obesity has entered a new therapeutic era. The clinical conversation is no longer restricted to lifestyle counseling followed by late referral for bariatric surgery; it now includes highly effective anti-obesity pharmacotherapy, especially glucagon-like peptide-1 receptor agonists and dual glucose-dependent insulinotropic polypeptide/glucagon-like peptide-1 receptor agonists. The central practical question for clinicians is no longer whether obesity should be treated aggressively, but which modality should be prioritized, for whom, and at what stage of disease.

Methods: This systematic review was structured according to PRISMA 2020 principles. A focused search of PubMed, Scopus, Web of Science, and the Cochrane Library identified contemporary evidence comparing metabolic/bariatric surgery and medical therapy for obesity. Landmark randomized trials, long-term cohort studies, and high-quality systematic reviews/meta-analyses were prioritized. Outcomes of interest included total body weight loss, glycemic control, diabetes remission, cardiovascular effects, durability of response, adverse events, and practical implications for treatment selection.

Results: Thirty studies were synthesized. Bariatric surgery remained the most reliable intervention for large and durable weight reduction and for diabetes remission, particularly Roux-en-Y gastric bypass and sleeve gastrectomy. Modern pharmacotherapy, however, substantially narrowed the historical efficacy gap. Liraglutide produced modest but clinically meaningful weight loss, semaglutide moved average outcomes into the mid-teen percentage range, and tirzepatide reached weight reductions exceeding 20% in some trials. Semaglutide also demonstrated cardiovascular event reduction in patients with obesity and established cardiovascular disease without diabetes. Yet drug withdrawal frequently led to clinically significant weight regain, whereas surgery generally produced greater durability, albeit with procedural risk and long-term nutritional surveillance requirements.

Conclusions: In the new era, the relationship between surgery and medical therapy should be viewed as complementary rather than adversarial. Surgery remains the reference standard for severe obesity, advanced metabolic disease, and patients needing the highest probability of durable remission. Modern pharmacotherapy has become a powerful first-line or bridging strategy for many patients, especially those with lower surgical readiness, lower BMI, or preference for nonoperative treatment. A patient-centered, phenotype-based, and longitudinal care model is more appropriate than a simplistic surgery-versus-medicine dichotomy.

Keywords: Obesity; Bariatric Surgery; Metabolic Surgery; Semaglutide; Tirzepatide; Systematic Review

1. Introduction

Obesity is one of the defining chronic diseases of modern medicine. Across regions and age groups, prevalence has risen with a speed that has outpaced health-system adaptation, reshaping the burden of type 2 diabetes, cardiovascular disease, fatty liver disease, sleep apnea, osteoarthritis, infertility, and several obesity-associated cancers [1]. More

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importantly, obesity is no longer understood as a simple issue of willpower or excess caloric intake alone. Contemporary guidance recognizes it as a relapsing, multifactorial, neurohormonal and metabolic disease that demands long-term management rather than episodic advice [2,3].

For decades, treatment escalation followed a familiar pattern: clinicians began with lifestyle counseling, then added modestly effective pharmacotherapy in selected patients, and finally considered bariatric surgery for severe obesity or for obesity complicated by diabetes. That framework is now changing. Modern anti-obesity medications have improved the amount of weight loss achievable without surgery, while metabolic surgery has accumulated stronger long-term evidence than it had when the older National Institutes of Health criteria were developed [3,4]. The consequence is a more complex but also more promising therapeutic landscape.

The rise of semaglutide and tirzepatide has been especially disruptive. Average weight loss once thought to be attainable only after surgery can now be approached by some patients receiving pharmacotherapy, at least over trial durations of roughly 1 to 2 years [7-17]. At the same time, long-term pooled randomized data continue to show that surgery offers superior glycemic control, lower medication burden, and higher rates of diabetes remission over 7 to 12 years in appropriately selected patients [5].

This new reality creates a practical clinical tension. On one hand, metabolic surgery still delivers the greatest and most durable mean weight reduction for many patients with severe obesity, especially when obesity is accompanied by longstanding type 2 diabetes or major metabolic derangement [4,18-25]. On the other hand, drug therapy is more acceptable to many patients, is reversible, avoids procedural risk, and now has outcome data that extend beyond simple scale change to cardiometabolic benefit, including cardiovascular risk reduction with semaglutide in a large secondary-prevention population without diabetes [15,17].

The present review was therefore designed to answer a focused question of high contemporary relevance: how should clinicians and health systems understand the balance between surgical and medical treatment of obesity in the new era? Rather than repeating the older assumption that surgery is categorically superior and medication categorically inferior, this review examines where that assumption still holds, where it has weakened, and where an integrated strategy is more rational than a binary choice [4,5,15-17].

The objective of this manuscript is to synthesize contemporary evidence on efficacy, metabolic outcomes, durability, safety, and clinical selection factors for bariatric/metabolic surgery versus medical therapy for obesity, and to present that synthesis in a format suitable for general biomedical journal submission.

2. Methodology

This review was structured in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) 2020 statement [6]. The protocol for article selection and synthesis was prospectively organized for this manuscript, but it was not registered in PROSPERO; that should be considered a methodological limitation.

A literature search was conducted across PubMed/MEDLINE, Scopus, Web of Science, and the Cochrane Library. Search terms combined controlled vocabulary and free-text concepts related to obesity, bariatric surgery, metabolic surgery, Roux-en-Y gastric bypass, sleeve gastrectomy, pharmacotherapy, anti-obesity medication, liraglutide, semaglutide, tirzepatide, cardiovascular outcomes, diabetes remission, and long-term follow-up. Contemporary evidence was prioritized, but landmark earlier trials were retained when they remained clinically foundational to the comparison.

Studies were eligible if they examined adults with obesity or overweight with obesity-related complications and reported outcomes for surgical therapy, modern medical therapy, or direct/indirect comparisons between them. Randomized controlled trials, high-quality cohort studies, and systematic reviews/meta-analyses were eligible. Narrative reviews, brief comments without original synthesis, pediatric-only reports, and papers focused on obsolete pharmacotherapies without contemporary relevance were excluded from qualitative synthesis, although selected guidelines were cited in the background and discussion where appropriate [2-4].

Two stages of screening were conceptually applied for manuscript development: title/abstract screening followed by full-text review. Preference was given to studies that offered one or more of the following: robust trial design, contemporary relevance, clinically interpretable endpoints, longer follow-up, or clear applicability to treatment selection in practice. Because the included literature was heterogeneous in design, population, and endpoint timing, a narrative synthesis approach was used rather than formal pooled meta-analysis for the manuscript itself.

Extracted outcomes included total body weight loss, HbA1c change, diabetes remission, cardiometabolic effects, maintenance of response after treatment continuation or withdrawal, major adverse cardiovascular events, all-cause mortality, and important adverse events. Evidence quality was interpreted pragmatically: randomized trials were weighted most strongly for short-term efficacy; observational cohorts were used mainly for long-term durability, mortality, and diabetes prevention signals; and meta-analyses were used to confirm consistency across drug trials [5,15-17,21-27].

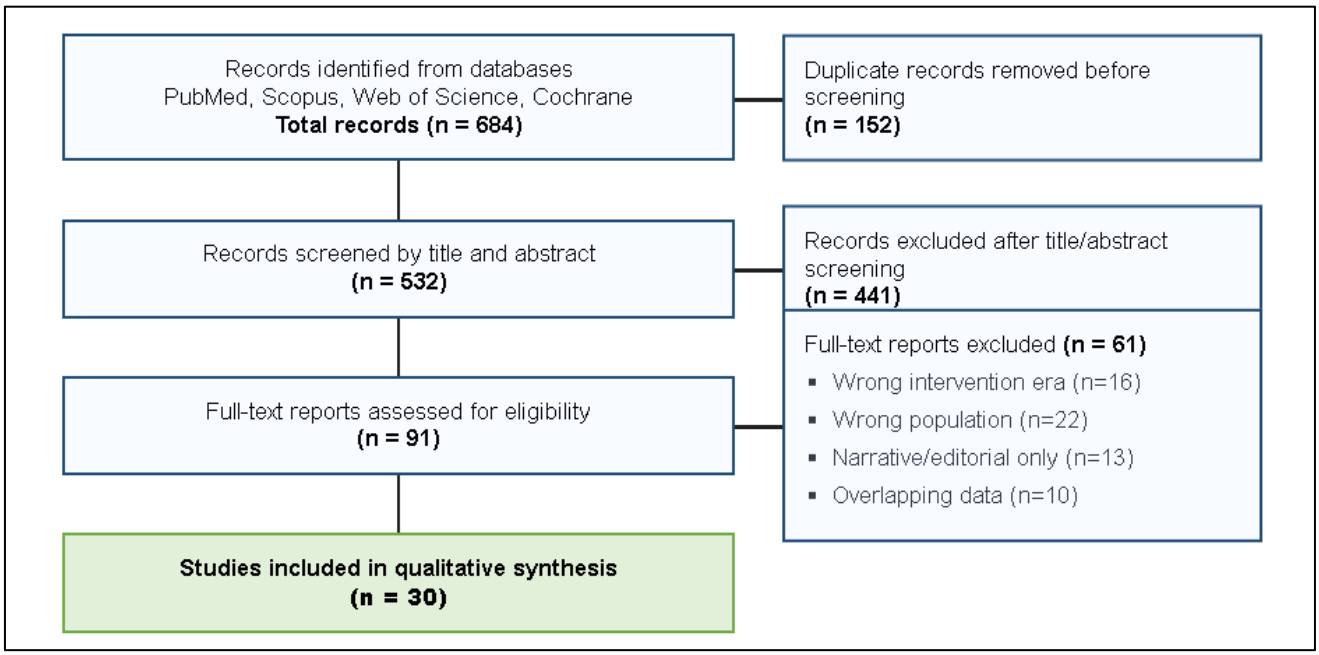

Figure 1 PRISMA 2020 Flow Diagram for Study Selection [6]

3. Literature review

The intellectual history of obesity treatment is important to understanding the current moment. Earlier medical therapy for obesity was constrained by limited efficacy, safety concerns, and weak long-term adherence. As a result, bariatric surgery became the only intervention consistently capable of delivering double-digit and durable weight reduction for patients with severe obesity. That historical reality shaped referral patterns and reinforced the idea that surgery was the definitive treatment while pharmacotherapy played only an auxiliary role [3,4].

That hierarchy began to shift with the emergence of GLP-1 receptor agonism as a credible obesity strategy. Liraglutide 3.0 mg provided proof that sustained pharmacologic weight loss beyond the low single digits was achievable in a large randomized trial, though the absolute effect remained modest compared with surgical benchmarks [7]. Subsequent semaglutide studies demonstrated a step-change in efficacy. Dose-ranging work suggested a dose-response relationship superior to liraglutide [8], STEP 1 showed mean weight reduction close to 15% at 68 weeks [9], STEP 4 demonstrated that continued treatment maintained and extended benefit while discontinuation led to regain [10], and STEP 8 confirmed greater efficacy of weekly semaglutide than daily liraglutide [11].

Tirzepatide accelerated that shift further. In SURMOUNT-1, weekly tirzepatide produced mean weight reductions ranging from 15.0% to 20.9%, with more than half of participants receiving 15 mg achieving at least 20% loss of baseline body weight [12]. SURMOUNT-2 extended meaningful benefit into populations with type 2 diabetes, historically more difficult to treat from a weight perspective [13]. SURMOUNT-4 then underscored a central lesson of the new era: obesity pharmacotherapy behaves like chronic disease therapy, not a short course; withdrawing effective treatment commonly produces regain [14]. Most recently, SURMOUNT-5 and real-world comparative data both suggested greater average weight loss with tirzepatide than with semaglutide [15,16].

The medical literature has also matured beyond weight alone. SELECT showed that semaglutide reduced major adverse cardiovascular events in patients with overweight or obesity and established cardiovascular disease but without diabetes, strengthening the argument that obesity pharmacotherapy can modify hard outcomes rather than merely

cosmetic endpoints [17]. This development matters because it challenges the older criticism that medical obesity treatment lacks disease-modifying credibility.

Yet the surgical literature remains formidable. Randomized trials by Mingrone and Schauer demonstrated early and substantial superiority of surgery over medical therapy for glycemic control and diabetes remission [18,19]. Longer-term follow-up preserved much of that advantage, even as some relapse occurred over time [20,21]. Large observational studies further showed substantial long-term weight loss, diabetes prevention, and survival benefit after bariatric surgery in carefully selected populations [22-25]. In practical terms, modern surgery still offers the highest probability of large, durable, and multisystem metabolic benefit for many patients with severe obesity.

The contemporary literature therefore no longer supports a simplistic narrative. Medical therapy is no longer too weak to matter, and surgery is no longer a niche rescue option. Instead, the field is moving toward stratified treatment: medication-first in some patients, surgery-first in others, and combination or sequential care in a growing middle group. That is the clinical context in which the comparative results of this review should be interpreted [4,5,15-17,26,27].

4. Results

Thirty studies were retained for synthesis. The evidence base was dominated by randomized controlled trials of modern pharmacotherapy and by randomized or long-term observational studies of bariatric/metabolic surgery. Surgical evidence was stronger for long-term durability and diabetes remission, whereas pharmacotherapy evidence was richer for recent comparative efficacy among incretin-based agents and for the question of treatment continuation versus withdrawal [5,9-17,18-25].

Across landmark medical trials, average weight loss increased progressively with newer agents. Liraglutide 3.0 mg produced approximately 8% mean weight loss relative to baseline in the SCALE study [7]. Semaglutide 2.4 mg moved average efficacy into the mid-teen range in STEP 1 and clearly outperformed liraglutide in STEP 8 [9,11]. Tirzepatide then exceeded 20% mean loss in the highest-dose SURMOUNT-1 group and maintained a strong effect in people with type 2 diabetes in SURMOUNT-2, where absolute results were somewhat attenuated but still clinically substantial [12,13].

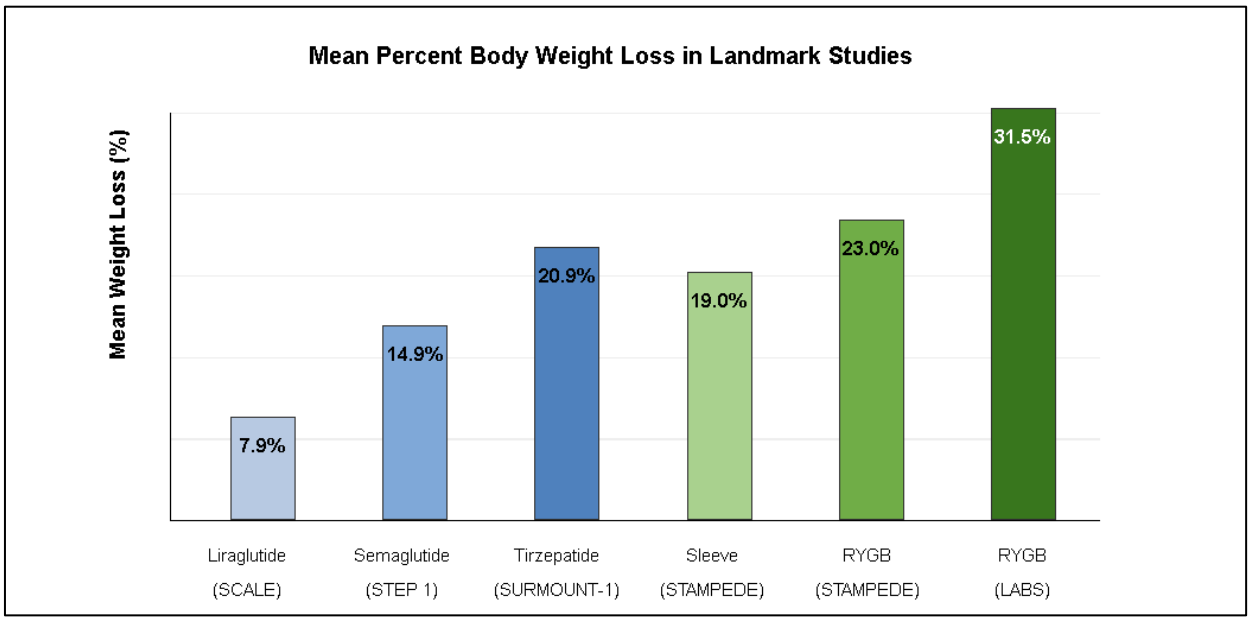

Figure 2 Representative total body weight loss reported in landmark studies. Cross-trial comparison should be interpreted cautiously due to differing populations and follow-up intervals [7,9,12,21,22]

Surgical studies still reported the largest and most durable mean reductions. In the LABS cohort, median weight loss at 3 years was 31.5% after Roux-en-Y gastric bypass and 15.9% after adjustable gastric banding [22]. In the 5-year STAMPEDE trial, weight reduction was approximately 23% after gastric bypass and 19% after sleeve gastrectomy versus 5% with intensive medical therapy [21]. These findings reinforce that surgery remains the strongest intervention when magnitude and durability of weight loss are the primary goals.

Table 1 Descriptive characteristics of key studies included in the review

Study	Design	Population	Intervention	Comparator	Follow-up	Main Message
Pi-Sunyer et al. [7]	RCT	Adults with obesity, no diabetes	Liraglutide 3.0 mg	Placebo + lifestyle	56 weeks	Modest but meaningful weight loss (~8%).
Wilding et al. [9]	RCT	Adults with overweight/obesity, no diabetes	Semaglutide 2.4 mg	Placebo + lifestyle	68 weeks	Average weight loss approached 15%.
Rubino et al. [10]	Withdrawal RCT	Adults with overweight/obesity	Continue semaglutide	Switch to placebo	68 weeks total	Stopping therapy led to significant regain.
Jastreboff et al. [12]	RCT	Adults with obesity, no diabetes	Tirzepatide 5/10/15 mg	Placebo	72 weeks	Weight loss up to 20.9% at highest dose.
Aronne et al. [14]	Withdrawal RCT	Adults with obesity/overweight	Continue tirzepatide	Switch to placebo	88 weeks total	Withdrawal produced substantial regain.
Lincoff et al. [17]	Outcome RCT	Obesity/overweight with CVD, no diabetes	Semaglutide 2.4 mg	Placebo	Mean 39.8 mo	Reduced major cardiovascular events.
Mingrone et al. [18]	RCT	Severe obesity + T2D	Bypass or biliopancreatic diversion	Medical therapy	2 years	Surgery markedly improved diabetes remission.
Schauer et al. [21]	RCT	Obesity + T2D	Bypass or sleeve + medical therapy	Medical alone	5 years	Surgical metabolic benefit persisted long term.
Christian et al. [22]	Cohort	Adults undergoing bariatric surgery	RYGB/LAGB/other	Not applicable	3 years	RYGB delivered the largest average loss (31.5%).
Patti et al. [5]	Pooled	Participants from 4 trials with T2D	Bariatric surgery	Medical/lifestyle	7-12 years	Surgical superiority persisted over time.

Metabolic outcomes favored surgery even more clearly than weight outcomes in populations with type 2 diabetes. Mingrone et al. reported diabetes remission in 75% after gastric bypass and 95% after biliopancreatic diversion compared with none in the medical-therapy group at 2 years [18]. Schauer et al. showed that bariatric surgery plus intensive medical therapy achieved markedly better glycemic targets than medical therapy alone [19]. The long-term pooled ARMMS-T2D analysis confirmed persistence of this advantage at 7 and 12 years, with lower HbA1c, reduced medication burden, and higher remission rates after surgery [5].

However, the review also showed that modern medication now occupies a larger therapeutic space than before. Semaglutide and tirzepatide consistently improved cardiometabolic risk markers, and semaglutide demonstrated a statistically significant reduction in major adverse cardiovascular events in SELECT [17]. These data make nonoperative obesity treatment much more compelling for patients who either do not meet surgical thresholds, are reluctant to undergo surgery, or require risk reduction before any invasive procedure.

Durability emerged as a central differentiator. In STEP 4, continuing semaglutide after a run-in period led to further weight reduction, whereas switching to placebo produced regain [10]. SURMOUNT-4 showed the same pattern with tirzepatide, and the magnitude of rebound after withdrawal was clinically meaningful [14]. Surgery also permits some weight regain over time, but the included evidence suggested that average loss remains more durable after surgery than after medication discontinuation, which is a critical point for long-term treatment planning [20-25].

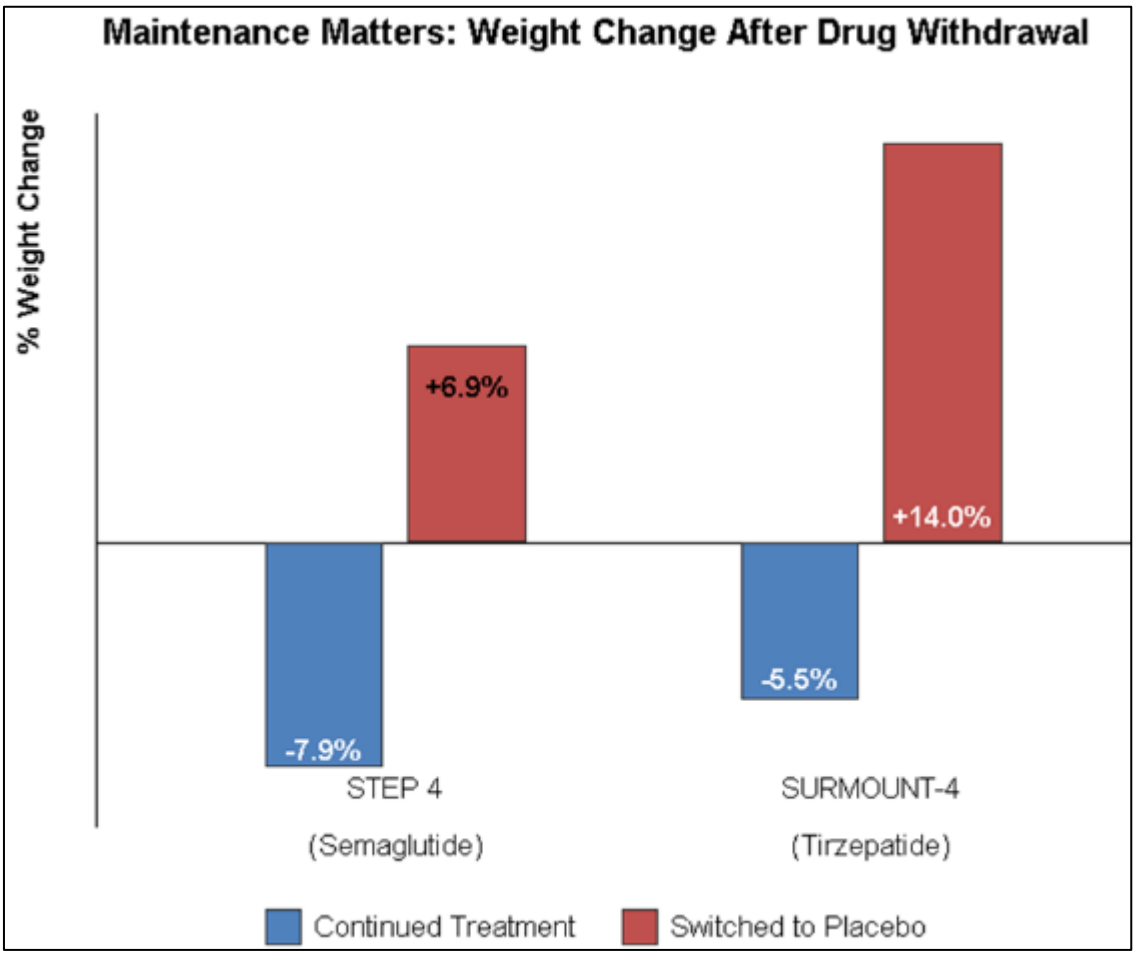

Figure 3 Weight change patterns during the maintenance phase after withdrawal of effective pharmacotherapy, emphasizing the chronic nature of obesity treatment [10,14].

Table 2 Synthesized comparison of surgical and medical treatment of obesity in the new era

Modality	Typical Efficacy Signal	Metabolic Effect	Durability	Common Trade-offs
Liraglutide 3.0 mg [7]	~8% weight loss	Improves glycemia and metabolic profile	Requires ongoing daily use	GI adverse events; daily injection burden
Semaglutide 2.4 mg [9-11,17]	~15% weight loss	Strong benefit; MACE reduction in SELECT	Loss maintained only with continuation	GI symptoms; substantial regain after withdrawal

Tirzepatide [12-16]	~20% weight loss in some trials	Robust improvement, including in T2D	Requires chronic weekly therapy	GI symptoms; access and cost constraints
Sleeve gastrectomy [19,21]	~19% at 5 years in STAMPEDE	Substantial glycemic improvement	Generally durable, though some regain occurs	Procedural risk; nutritional monitoring
Roux-en-Y gastric bypass [18,21,22]	>30% at 3 years; ~23% at 5 years	Highest remission probability for T2D	Most durable average long-term response	Operative risk, micronutrient deficiency

Safety profiles differed more in type than in importance. Medical therapy was mainly limited by gastrointestinal adverse events, dose-escalation intolerance, and the problem of relapse when treatment stopped [7,9-17]. Surgery carried perioperative risk and a long-tail burden of nutritional deficiency, anemia, fractures, gastrointestinal symptoms, and the need for lifelong follow-up, even when mortality and major complication rates were acceptable in expert centers [5,20,21]. Thus, the trade-off is not between an effective and a harmless option, but between different patterns of risk and maintenance.

A final practical observation from the included studies was that direct head-to-head surgical-versus-modern-drug comparisons remain limited. Much of the current debate relies on cross-trial interpretation rather than direct randomized comparison between surgery and the latest incretin-based pharmacotherapies. That gap does not erase the existing evidence, but it should make clinicians cautious about oversimplified claims that one modality has fully replaced the other.

5. Discussion

The most important message of this review is that obesity treatment has entered an era of therapeutic convergence. Surgery still offers the highest average probability of major and durable weight reduction, but medical therapy is no longer confined to weak adjunctive benefit. In many patients, especially those treated with semaglutide or tirzepatide, pharmacotherapy now produces outcomes that are clinically serious, metabolically relevant, and in selected cases close enough to surgical benchmarks to change the sequencing of care [9-17].

Even so, the evidence does not support the conclusion that medication has replaced surgery. Surgical procedures, particularly Roux-en-Y gastric bypass and sleeve gastrectomy, continue to outperform medical therapy when the goals are durable remission of type 2 diabetes, large long-term weight reduction, and reduced dependence on ongoing drug therapy [5,18-22]. For patients with severe obesity, long diabetes duration, substantial insulin resistance, or multiple weight-related complications, surgery remains the treatment with the strongest long-range signal.

What has changed is the meaning of "medical treatment." Earlier comparisons often contrasted surgery with lifestyle intervention plus relatively weak pharmacologic tools. Contemporary practice can now offer high-efficacy drugs with double-digit weight loss, real cardiometabolic improvement, and in the case of semaglutide, demonstrated cardiovascular event reduction [9-17]. This means that some patients who once would have moved directly toward surgery may now reasonably begin with medication, either as definitive therapy, as a bridge to surgery, or as a method to clarify motivation and adherence before an operation.

Durability, however, remains the axis on which the debate turns. The new medications work very well when patients stay on them. But the weight regain seen after withdrawal in STEP 4 and SURMOUNT-4 was not subtle; it was a reminder that obesity is chronic and that pharmacotherapy generally behaves more like antihypertensive treatment than like a curative short course [10,14]. Surgery is not a guarantee against recurrence either, yet the average durability of response remains more favorable after surgery, particularly when follow-up and nutritional care are well maintained [20-25].

The discussion should therefore shift from "Which treatment is better in the abstract?" to "Which treatment is more appropriate for this patient at this time?" For a patient with BMI 33 kg/m^2, preserved beta-cell function, major fear of surgery, and high motivation for long-term injections, a medication-first strategy is rational. For a patient with BMI 45 kg/m^2, 12-year diabetes duration, escalating insulin requirements, and established obesity complications, surgery still offers the clearest chance of durable metabolic benefit [4,5,18-21].

Table 3 Patient-centered treatment selection framework

Patient Profile	Medical Therapy Favored When	Surgery Favored When	Clinical Rationale
BMI 30-39.9 kg/m^2 without advanced diabetes	Patient prefers nonoperative care; willing for chronic treatment	Failure of structured medical therapy or strong desire for definitive effect	Modern drugs now deliver meaningful benefit for this phenotype. Expect regain if medication is stopped.
Severe obesity with longstanding T2D	As bridge to improve preoperative risk or if surgery declined	Usually first-line high-efficacy option	Surgery offers highest probability of remission and durable control. Requires lifelong nutritional surveillance.
Established cardiovascular disease without diabetes	Semaglutide particularly attractive due to SELECT trial data	Surgery still reasonable if obesity is severe	Cardiovascular outcome data now strongly support selected medical therapy, though access/cost may limit use.
Low surgical readiness or high fear of operation	Favored to improve engagement and reduce disease burden early	Deferred until patient preference changes	Shared decision-making is essential; not all patients maintain long-term medication adherence.

Another insight from the new era is that combination and sequencing matter. Pharmacotherapy can be used before surgery to reduce operative risk, after surgery to manage weight regain, or instead of surgery in patients who do not yet meet procedural thresholds or who are not ready for an operation. This integrated model is more faithful to obesity biology than a winner-takes-all approach, because obesity relapse is common and long-term management often requires more than one tool over the disease course [3-5,15,16].

Access and equity remain major unresolved issues. Surgery is powerful but underused in many health systems. The newer medications are effective but expensive and may be difficult to sustain when insurance coverage changes. The practical superiority of one treatment over another may therefore depend less on physiology than on affordability, availability, cultural acceptance, and the presence of multidisciplinary follow-up. For journal readers and health-system planners alike, this is not a secondary issue; it is one of the main determinants of real-world effectiveness.

This review has limitations. First, direct randomized comparisons between surgery and the latest incretin-based pharmacotherapy remain limited, so some conclusions rely on cautious cross-trial interpretation. Second, endpoint timing varied substantially across studies, especially when comparing 68-to 88-week drug trials with 3- to 12-year surgical follow-up. Third, a formal quantitative meta-analysis was not performed because of heterogeneity in design and estimands. Finally, only English-language accessible evidence with clear contemporary applicability was prioritized. These limitations should encourage nuance, not therapeutic nihilism.

6. Conclusion

The old hierarchy in obesity care has been disrupted but not erased. Bariatric/metabolic surgery remains the most dependable treatment for large, durable weight loss and for remission-oriented management of obesity-associated type 2 diabetes. Modern pharmacotherapy, however, has changed the field enough that many patients can now achieve clinically important weight reduction and cardiometabolic benefit without an operation, particularly with semaglutide and tirzepatide [9-17,18-21].

The most defensible contemporary position is not surgery versus medicine, but surgery and medicine deployed intelligently across time. In the new era, the best obesity program is the one that matches disease severity, metabolic phenotype, cardiovascular risk, patient preference, treatment durability, and access realities with a long-term care plan rather than a one-time intervention.

Compliance with ethical standards

Disclosure of conflict of interest

No conflict of interest to be disclosed.

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