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The rise of ileal bypass surgery in the United States: A cautionary tale for Metabolic and Bariatric Surgery: From jejuno-ileal bypass to duodeno-ileal bypass

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Abstract

The landscape of metabolic and bariatric surgery (MBS) has become increasingly complex with the proliferation of intestinal bypass procedures and the rise in ileal bypass (IBS) procedures (SADI-S and DS) in the United States, alongside a confusing array of procedure names that fail to reflect underlying physiology. We propose an anatomy-based classification distinguishing jejunal bypass (JBS), including RYGB, OAGB, and SASJ, from ileal bypass (IBS), including SADI-S, BPD/DS, SASI, and type I distalization, based on the site of intestinal anastomosis. This classification enables better patient selection, facilitates benefit-risk assessment of new procedures like SASJ and SASI, highlights the importance of standardized measurement of biliopancreatic limb (BPL) length, common channel (CC), and total alimentary limb length (TALL) to prevent malnutrition, and promises to improve comparative research, individualized procedure selection, and future surgical innovation.

Introduction

The history of metabolic and bariatric surgery (MBS) in the United States began with high morbidity and mortality after jejuno-ileal bypass surgery (JIB) [1] and slowly evolved toward jejunal bypass surgery (JBS), represented by Roux-en-Y gastric bypass (RYGB). In contrast, ileal bypass surgery (IBS) continued to grow in Europe, represented by biliopancreatic diversion (BPD) and biliopancreatic diversion with duodenal switch (BPD/DS). Recently, in the US, ASMBS approved a form of IBS: single-anastomosis duodeno-ileal bypass with sleeve gastrectomy (SADI-S), and there has been a 280% increase in IBS [2].

This proliferation of MBS procedure names has become confusing for patients, young surgeons, and referring physicians. Furthermore, the traditional classifications of MBS as restrictive, malabsorptive, or mixed no longer reflect the true mechanisms of MBS, particularly as GLP-1 receptor agonists and incretin-based therapies have demonstrated that significant weight loss and metabolic benefits can be achieved through hormonal modulation rather than restriction or malabsorption alone. Moreover, the impact of biliopancreatic limb (BPL), common channel (CC), and total alimentary limb length (TALL) on weight loss, metabolic improvement, and malnutrition risk may be better interpreted through the anatomical location of the bypass (JBS vs. IBS) than by the procedure's name [3,4].

The adoption of ileal bypass surgery (IBS) in the United States has increased substantially. ASMBS estimates show that BPD/DS procedures increased from 1,588 in 2017 to 3,775 in 2023, while SADI-S was reported separately from 2020 onward and increased from 488 procedures in 2020 to 2,387 in 2023 [2]. Together, these data indicate a substantial expansion of IBS in US metabolic and bariatric practice. This trend is concerning because IBS carries significantly higher malnutrition rates than JBS. These risks of IBS are amplified by two factors: the known variability in small bowel length (350–1000 cm), which may lead to a variable BPL while creating the same CC and TALL in IBS [5], and poor adherence to postoperative follow-up, a common challenge in MBS, with nearly 40% of patients lost within the first postoperative year, which is particularly consequential after IBS [6]. The combination of these factors leaves patients vulnerable to delayed detection of nutritional complications after IBS.

A New Anatomy-Based Classification: JBS vs. IBS

The World Consensus Meeting on Standardization of Bariatric Metabolic Procedures highlighted standardized anatomical measurements to improve procedural reproducibility and outcome comparison [7]. Building on this principle, we propose an anatomy-based classification distinguishing jejunal bypass surgery (JBS) from ileal bypass surgery (IBS) according to the site of nutrient diversion and the amount of functional absorptive bowel retained. This framework is particularly relevant to the emergence of procedures such as sleeve gastrectomy with single anastomosis sleeve jejunostomy (SASJ) and sleeve gastrectomy with single anastomosis sleeve ileostomy (SASI).

Physiologically, the small intestine is an important endocrine organ, with L-cell density generally increasing toward the distal small intestine and colon. The site of nutrient diversion determines the length of the functional absorptive bowel, including the common channel (CC), total alimentary limb length (TALL), and consequently the effective biliopancreatic limb (BPL) length, and influences distal nutrient delivery to ileal L-cells, a mechanism central to incretin release [8–11]. This distinction is best illustrated by type I distalization of RYGB, in which relocating the Roux limb from the jejunum toward the ileum shifts the RYGB from JBS to IBS and may increase metabolic efficacy at the expense of greater nutritional risk [4,12]. In addition, the length of the CC and TALL in type I distalization affects the rate of malnutrition after type I distalization, and at least 400 cm of TALL is needed to prevent malnutrition [13].

Rather than focusing on the names of MBS procedures, this new classification emphasizes the anatomical variables (limb lengths and anastomotic site) that truly define the extent and location of intestinal diversion. Accordingly, JBS (RYGB, OAGB, and SASJ) has a shorter BPL, a longer CC/TALL, and delivers nutrients farther from L-cells, resulting in lower malnutrition but less weight loss. In contrast, IBS (SADI-S, BPD/DS, SASI, and type I distalization of RYGB) has a longer BPL, a shorter CC/TALL, and delivers nutrients closer to L-cells, resulting in greater weight loss but higher rates of malnutrition (Fig. 1).

Figure 1. Conceptual relationship between metabolic efficacy and nutritional risk: Jejunal Bypass (JBS) vs. Ileal Bypass (IBS)

Clinical Implications of the Classification:

This classification has several important implications. Critically, it enables surgeons, patients, and referring physicians to evaluate new procedures, like SASJ and SASI, within a consistent JBS vs. IBS framework, facilitating benefit-risk assessment of weight loss and metabolic improvement versus malnutrition. Moreover, it allows better patient selection by matching the degree of intestinal diversion to the patient's metabolic needs, nutritional reserve, and the team's expertise. Additionally, a higher degree of scrutiny is needed for patients undergoing IBS to avoid the long-term sequelae of malnutrition, including proper patient selection, documentation of patient risk, and education, as well as plans for long-term follow-up. Finally, even JBS procedures with a longer BPL, such as OAGB and type I distalization, may increase the risk of malnutrition. Accordingly, standardized reporting of CC, BPL, and

TALL and, when feasible, total small-bowel length should be incorporated, consistent with the broader principle of anatomical standardization advocated by the World Consensus Meeting [7].

Table 1. Anatomy-Based Physiological Classification of Contemporary Intestinal Bypass Procedures

Metabolic Efficacy and Nutritional Cost of Ileal Bypass:

IBS achieves superior weight loss and metabolic outcomes through distal nutrient delivery to ileal L-cells, not simply through malabsorption or a shorter CC. The metabolic effects of distal nutrient delivery are likely multifactorial and may involve altered nutrient transit, enteroendocrine signaling, bile acid metabolism, glucose absorption, and intestinal adaptation rather than GLP-1 stimulation alone. Santoro et al. demonstrated that lengthening the CC from 80–100 cm to 200–220 cm in transit bipartition reduced diarrhea without compromising weight loss [14]. In multicenter studies, IBS procedures like SASI achieve 84.1% EWL and 88.3% T2DM remission at 12 months [15]. SADI-S achieves 60.1% remission, approaching 95% in some series [16,17], while BPD/DS outperforms RYGB and sleeve gastrectomy in weight loss [18].

However, these benefits come at a substantial nutritional cost. Sewefy et al. found significantly higher rates of malnutrition (58% vs. 27.6%) and reoperation (11.4% vs. 2.3%) after SASI compared with SASJ [19]. Long-term data further demonstrate that the nutritional consequences of SASI are strongly dependent on its anatomical configuration. In a recent 10-year cohort, the initial configuration with a 250-cm common channel and a wide 4–6 cm gastroileal anastomosis was associated with malnutrition in 60% of patients and surgical reversal in 40%, whereas longer common-channel configurations with a 2.5-cm anastomosis were associated with substantially fewer nutritional complications, with no surgical revisions in the 350-cm group [20].

These findings provide clinical support for the concept that nutritional risk is determined not simply by the procedure name, but by the specific configuration and degree of intestinal diversion. BPD/DS carries similarly concerning long-term risks: protein deficiency reaches 30% at year 9, with 45% of patients developing low zinc levels by year 5 [21]. Even SADI-S is associated with zinc deficiency in 38.5% and vitamin D deficiency in 30.8% of patients at one year [17].

Nutritional Profile of Jejunal Bypass:

In contrast, JBS procedures (RYGB, OAGB, and SASJ) offer a safer profile with fewer nutritional complications while maintaining comparable metabolic efficacy. A 2025 meta-analysis found that SASI provided only a modest weight-loss advantage over OAGB but had significantly higher complication rates (p = 0.004), with remission of T2DM and other comorbidities similar to OAGB [22]. SASJ, a newer jejunal bypass that preserves duodenal transit [23], has demonstrated substantial weight loss in early comparative studies, with outcomes broadly comparable to RYGB [24], while showing significantly fewer nutritional deficiencies and reoperations than SASI [18]. These findings suggest that preserving a larger

absorptive bowel can achieve excellent metabolic outcomes without the nutritional cost of ileal diversion.

Impact on Glucose Homeostasis:

Intestinal reconstruction also affects glucose homeostasis. Available comparative data suggest that post-bariatric hypoglycemia (PBH) may be more frequently detected after certain JBS procedures, particularly RYGB, than after distal procedures such as SADI-S or BPD/DS. However, the underlying mechanisms remain incompletely defined, though they are most likely related to a longer CC. An animal study by Pattou et al. demonstrated that very little glucose is absorbed in the Roux limb, whereas a longer CC increases glucose absorption [25,26]. A comparative study found that significantly more RYGB patients experienced asymptomatic hypoglycemia than those who underwent SADI-S or BPD (63.6% vs. 22.2% and 12.5%, respectively; $p < 0.05$) [27].

These findings suggest that the risk of PBH should be considered when selecting between JBS and IBS, particularly in patients with pre-existing glucose metabolism disorders.

Clinical Recommendations

This JBS and IBS framework should not be interpreted as favoring one procedure over another. Jejunal and ileal bypasses may represent complementary strategies with different risk-benefit profiles for a diverse patient population with obesity. Jejunal diversion (SASJ, OAGB, RYGB) generally provides an excellent balance between efficacy and nutritional safety, making it suitable for most patients. Ileal diversion (SASI, SADI-S, BPD/DS) offers greater metabolic potency and may be appropriate for selected patients with severe obesity or refractory diabetes, provided that rigorous lifelong nutritional monitoring is ensured. The choice of procedure should therefore consider the severity of obesity and metabolic disease, nutritional risk, anatomical configuration, patient preferences, and the capacity for lifelong postoperative surveillance (Table 2).

Table 2. Procedure Selection Based on Jejunal vs. Ileal Bypass Characteristics

Conclusion

In conclusion, we believe that modern intestinal bypass MBS procedures should be interpreted according to measurable anatomical variables, including anastomotic location, BPL length, CC length, TALL, and, whenever possible, total small bowel length. Standardizing these anatomical parameters would improve comparative research, individualized procedure selection, and future surgical innovation. Procedure names describe the operation; intestinal anatomy largely determines its physiological consequences.

Declarations

Ethics Approval: Not applicable. This study is a review and classification proposal based on published literature and does not involve human or animal subjects, clinical data, or patient interventions. No ethics

approval was required.

Consent to Participate: Not applicable.

Consent for Publication: Not applicable.

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Author Contribution

All authors contributed to the conception, design, literature review, data interpretation, drafting, and critical revision of the manuscript. All authors approved the final version and agree to be accountable for all aspects of the work.

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Tables

Table 1. Anatomy-Based Physiological Classification of Contemporary Intestinal Bypass Procedures

Parameter	JEJUNAL BYPASS SURGERY (JBS)	ILEAL BYPASS SURGERY (IBS)
Representative procedures	RYGB, OAGB, SASJ	SASI, SADI-S, BPD-DS
Site of nutrient diversion	Proximal jejunum	Distal ileum
Common channel (CC)	Longer variable (>400 cm)	Shorter (100–300 cm)
Biliopancreatic limb (BPL)	Shorter (50–200 cm)	Longer variable (150–650 cm)
Functional absorptive bowel	Preserved	Reduced
GLP-1/PYY stimulation	Moderate	High
Bile acid signaling	Moderate	High
Weight-loss / Metabolic efficacy	High	Potentially higher
Protein malnutrition	Lower	Higher
Micronutrient deficiency	Lower	Higher
Diarrhea/steatorrhea	Less frequent	More frequent
Reoperation/reversal rate	Lower	Higher
Reported post-bariatric hypoglycemia	More common / longer common channel	Less common / shorter common channel
Endoscopic access to duodenum/biliary tree	Generally more accessible	More limited/variable
Nutritional surveillance	Standard lifelong follow-up	Intensive lifelong follow-up

(*) Comparative evidence remains heterogeneous and is strongly influenced by limb configuration, common-channel length, anastomotic diameter, and follow-up duration.

Table 2. Procedure Selection Based on Jejunal vs. Ileal Bypass Characteristics

Patient Profile	Suggested Strategy	Rationale
Most patients with obesity and metabolic disease	**Jejunal bypass** (SASJ, OAGB, RYGB)	Optimal balance of efficacy and safety; lower nutritional risk
Patients in whom greater weight-loss efficacy is prioritized	**Ileal bypass** (SASI, SADI-S, BPD-DS)	Superior metabolic potency requires intensive surveillance
Patients with severe or refractory metabolic disease in whom greater distal stimulation is considered	**Ileal bypass** or extended BPL RYGB	Maximizes distal enteroendocrine stimulation
Patients with prior biliary or pancreatic disease	**SASJ**	Preserves papillary access to the duodenum
Patients with limited follow-up capacity	**Jejunal bypass**	Lower nutritional risk; less intensive surveillance
Patients accepting lifelong surveillance	**Ileal bypass**	Greater metabolic benefit for willing patients

Figures

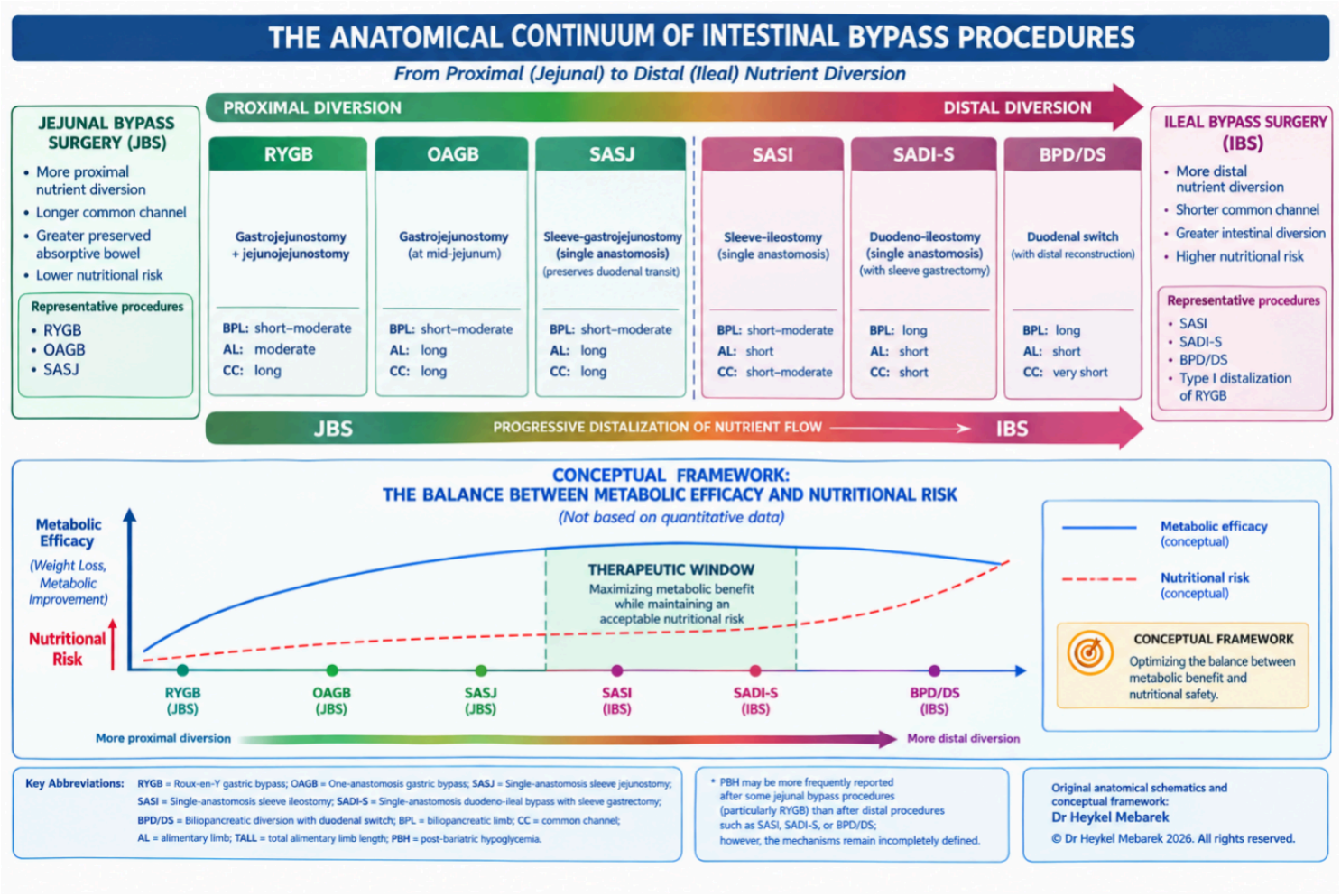


Figure 1

New Anatomy-Based Classification of Intestinal Bypass Procedures: Jejunal Bypass (JBS) vs. Ileal Bypass (IBS)

The figure illustrates the continuum of intestinal diversion, with progressive distalization enhancing enteroendocrine stimulation but increasing nutritional risk