Review Article

General Surgery
SURGICAL TECHNOLOGY INTERNATIONAL Volume 46
doi: 10.36922/sti.0280

Transit Bipartition—From L-Cell Physiology to Metabolic Outcomes: A Narrative Review

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ABSTRACT

Metabolic surgery is designed to enhance the hormonal effects of incretins, rather than to induce purely restrictive or malabsorptive outcomes. Transit bipartition is an emerging metabolic procedure that aims to shorten the time to peak plasma concentrations of incretins, such as glucagon-like peptide-1 and peptide YY. This is achieved by accelerating the transit of chyme to the distal ileum, thereby reactivating and chronically stimulating its endocrine function. In this narrative review, we explore the underlying hormonal mechanisms, beginning with the physiology of the L cell, and elucidate the advantages of transit bipartition. We also summarize findings from current meta-analyses on the procedure's outcomes and complications, followed by a discussion of its advantages and disadvantages. Based on the existing theoretical and scientific evidence, we conclude that sleeve gastrectomy with transit bipartition is a safe and effective procedure with an acceptable rate of short- to medium-term complications.

***Keywords*:** Gut hormones; L cell; Metabolic surgery; One-anastomosis transit bipartition; Roux-en-Y transit bipartition; Single anastomosis sleeve ileal bypass; Sleeve gastrectomy with transit bipartition

INTRODUCTION

Metabolic surgery has evolved beyond simple mechanical restriction and malabsorption to a more nuanced approach targeting the body's endocrine system. The primary biological objective of modern metabolic procedures is to enhance the hormonal effects of incretins, rather than merely inducing restrictive or malabsorptive states. In this context, transit bipartition has emerged as a promising metabolic surgery. Its fundamental goal is to reduce the time required to achieve peak plasma concentrations of key incretin hormones, namely, glucagon-like peptide-1 (GLP-1) and peptide YY (PYY). This is accomplished by

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doi: 10.36922/sti.0280

accelerating the passage of chyme into the distal ileum, which in turn reactivates and chronically stimulates the endocrine cells of this intestinal segment.

In this narrative review, we delve into the hormonal mechanisms that underpin the efficacy of transit bipartition, beginning with the physiology of the enteroendocrine L cell. By describing the intricate hormonal signaling pathways, we aim to illuminate the advantages of this metabolic surgical procedure. We further synthesize current evidence from meta-analyses regarding the clinical outcomes and complication profiles associated with transit bipartition, culminating in a balanced discussion of its advantages and disadvantages.

METHODS

A literature search was conducted on the PubMed database using the following search terms: "L cells," "incretins," "transit bipartition," "OATB/RYTB," "SASI," and "metabolic surgery." The most relevant articles were selected based on their contribution to the understanding of physiological mechanisms, surgical techniques, and clinical outcomes. This information was then synthesized into a narrative review based on the most recent scientific evidence.

PHYSIOLOGY OF INTESTINAL HORMONES

The L cell

The gastrointestinal (GI) tract is recognized as the largest endocrine organ in the human body. Dispersed throughout its epithelial lining are enteroendocrine cells (EECs), which, despite constituting less than 1% of the total epithelial cell population, exert profound physiological effects and are a cornerstone of the gut–brain axis.[1] Over 15 distinct types of EECs have been identified, collectively secreting more than 20 peptide hormones that regulate a vast array of processes, including intestinal motility, gastric acid secretion, and energy homeostasis.

A key function of EECs is to act as chemosensors, detecting various food components, such as proteins, lipids, and carbohydrates, as well as microbial metabolites, including short-chain fatty acids, through specific receptors. This sensing triggers the release of hormones that modulate food intake and digestion (Figure 1).[2] To perform this function, EECs often exhibit a characteristic open-type, cone-shaped morphology, with an apical end featuring microvilli in direct contact with the gut lumen and a basal end adjacent to the lamina propria, allowing for the release of hormones into the bloodstream.3 The microvilli are therefore in immediate contact with the luminal content, the detection of which can lead to the release of hormones from secretory granules directly into adjacent blood vessels. Gastric distension and the release of upper GI tract hormones, such as cholecystokinin (CCK) from I cells, trigger short-term satiety processes in the upper GI tract.4 However, long-term satiety is potentially determined by other mechanisms, which may include direct nutrient sensing leading to the release of anorexigenic intestinal hormones from enteroendocrine L cells. Mature L cells are commonly defined as enteroendocrine epithelial cells that express the preproglucagon gene. The post-translational processing of preproglucagon is tissue-specific and, therefore, produces different hormonal products in the pancreas and intestine. L cells, traditionally described as having a distinct cone-shaped morphology, secrete the cleavage products of prohormone convertase 1: GLP-1, GLP-2, glicentin, and oxyntomodulin.5 The hormones glicentin and oxyntomodulin are two potent stimulators of the GLP-1 receptor, although with a receptor–ligand affinity of 10–100 times lower than GLP-1. However, on their own, they are capable of inducing the same effects as GLP-1.5 GLP-2 regulates gastric motility, gastric acid secretion, intestinal hexose transport, and enhances the barrier function of the intestinal epithelium.6 The localization of L cells in humans is absent in the esophagus, stomach, and duodenum, very low in the proximal jejunum, and increases to become excessively high in the distal jejunum and ileum, progressively decreasing in the colon while being maximal in the rectum.7 Immunostaining and fluorescence-activated cell sorting have revealed that L cells, in addition to the prohormone convertase 1 cleavage products (GLP-1, GLP-2, glicentin, and oxyntomodulin), co-secrete distinct peptides depending on their location: L cells in the upper small intestine secrete glucose-dependent insulinotropic polypeptide (GIP) and neurotensin, thus exhibiting certain similarity to nearby K cells; while L cells in the lower small intestine show high levels of co-localization with PYY and CCK.8,9 However, it should be noted that other EEC populations in the stomach, duodenum, and pancreas secrete hormones such as gastrin, somatostatin, secretin, CCK, ghrelin, and motilin. Although numerous studies are ongoing, it is clear that each GI tract segment performs specific hormonal functions as food content passes through it. This discovery allows us to draw a significant conclusion in bariatric and metabolic surgery: that any intestinal tract "excluded" from food transit following surgery inevitably leads to a loss or reduction of hormonal function, whether positive or negative.

The "ileal brake" concept

The "ileal brake" is a powerful physiological feedback mechanism activated when nutrients reach the distal ileum. As previously noted, L cells in this region secrete GLP-1 and PYY in response to the presence of carbohydrates, lipids, and proteins. The direct administration of these nutrients into the human ileum has been shown to stimulate this brake, leading to a potent reduction in food intake and an increase in satiety.[10,11]

The exogenous administration of either PYY or GLP-1 mimics these effects, reducing gastric emptying and pancreatic secretions.[12] This slowing of upper GI transit is partly achieved through the inhibition of motilin release by PYY, which reduces peristaltic contractions.[13] Interestingly, PYY also tonically accelerates colonic peristalsis via Y1 receptors, possibly to prepare the colon for the influx of nutrients from the small intestine. PYY further regulates gastric function by binding to inhibitory Y1 receptors in the gastric mucosa, thereby inhibiting vagally stimulated acid secretion, and also influences pancreatic islet function to modulate glucose homeostasis.[14]

These circulating gut hormones can cross the blood–brain barrier in permeable regions, such as the area postrema, which communicates directly with the nucleus of the solitary tract.[15] From there, signals are relayed, including those via the vagus nerve, to central hypothalamic nuclei that control energy homeostasis, where receptors for GLP-1 and PYY are widely expressed.[16–18] This gut–brain signaling axis is fundamental to the anorexigenic effects of these hormones.

doi: 10.36922/sti.0280

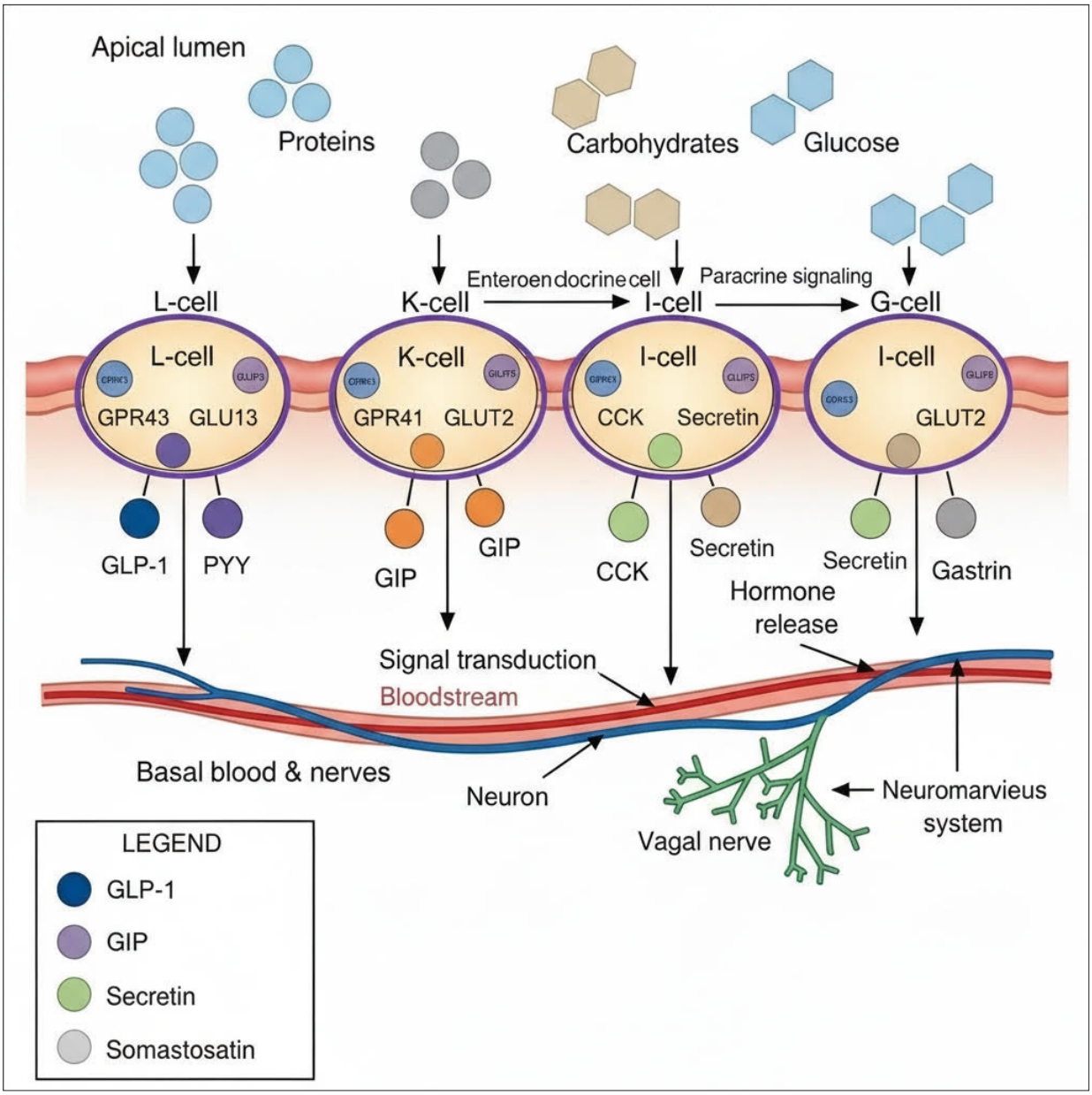

Figure 1. L cell function and hormonal secretion. This diagram illustrates how food components and gut microbiota metabolites are sensed by enteroendocrine cells, leading to the secretion of various GI tract hormones that act via paracrine, neuronal, and endocrine pathways to regulate metabolism and gut function. Figure created by authors. Abbreviations: GLP-1: glucagon like peptide 1; GIP: glucose-dependent insulinotropic polypeptide; CCK: cholecystokinin; GLUT: GLUcose transporter; GI: gastrointestinal.

Systemic effects of L-cell hormones (incretins)

L-cell hormones, particularly the incretins GLP-1 and PYY, exert a wide range of systemic effects that are highly beneficial for metabolic control. These hormones potently stimulate glucose-dependent insulin secretion and simultaneously suppress hepatic gluconeogenesis, thereby improving glycemic control.[19] They also enhance overall insulin sensitivity in peripheral tissues. Beyond glucose metabolism, these hormones play a crucial role in maintaining the health and mass (trophism) of pancreatic beta-cells and facilitate the clearance of triglycerides from the circulation. Their influence extends profoundly to appetite regulation by reducing the rate of gastric emptying, which promotes early satiety and modifies food preferences away from energy-dense foods. These actions collectively contribute to a reduction in overall food intake and support weight loss. Furthermore, emerging evidence suggests that incretins increase energy expenditure, partly by promoting the "browning" of white adipose tissue, and have been shown to reduce hepatic steatosis, highlighting their multifaceted role in combating obesity and its related comorbidities.

HORMONES AND FAT METABOLISM

Perhaps one of the most therapeutically relevant actions of GLP-1 is its comprehensive regulation of lipid metabolism. It orchestrates a multipronged strategy to reduce excess fat by targeting both the liver and adipose tis-

doi: 10.36922/sti.0280

sue—the body's primary sites of energy storage and processing.

Action in the liver

The liver is a central hub for lipid homeostasis, and GLP-1 signaling plays a decisive role in shifting the balance away from fat accumulation. It actively inhibits hepatic lipogenesis (fat synthesis) by activating pathways, including the AMP-activated protein kinase pathway. This, in turn, suppresses the expression of key lipogenic enzymes, such as sterol regulatory element-binding protein 1c, fatty acid synthase, and acetyl-CoA carboxylase, effectively reducing the liver's capacity to synthesize new triglycerides. In addition to halting fat production, GLP-1 promotes the breakdown and oxidation of existing fat. It activates master regulators of mitochondrial function, such as sirtuin-1 and peroxisome proliferator-activated receptor gamma coactivator 1-alpha, enhancing fatty acid oxidation and reducing the lipid load within hepatocytes. GLP-1 also influences cholesterol management by promoting cholesterol efflux from liver cells through the increased expression of transport proteins, such as ATP-binding cassette, subfamily A, member 1 and ATP-binding cassette transporter G1, a crucial step in reversing cholesterol transport.

Action in adipose tissue

In adipose tissue, GLP-1's influence extends directly to adipocytes, remodeling their function to be more metabolically favorable. One of its most significant properties is the ability to promote the "browning" of energy-storing white adipose tissue into energy-burning beige or brown adipose tissue. This process increases thermogenesis and overall energy expenditure, driven by the increased expression of uncoupling protein 1. GLP-1 also modulates the adipocyte lifecycle by regulating differentiation, promoting lipolysis (the release of stored fatty acids), and reducing local inflammation within adipose tissue, a key contributor to insulin resistance. The clinical significance of these mechanisms is underscored by the remarkable efficacy of GLP-1 receptor agonists in treating obesity and non-alcoholic fatty liver disease, demonstrating that their benefits extend far beyond simple appetite suppression.

A DIRECT ROLE IN NUTRIENT ABSORPTION

While GLP-1 is renowned for its metabolic effects, PYY has a distinct and essential role in the fundamental process of nutrient absorption. Research has revealed that PYY is indispensable for normal nutrient absorption in the small intestine.[19] In individuals lacking EECs and therefore PYY, any attempt at enteral feeding leads to severe malabsorptive diarrhea, indicating a complete failure of nutrient absorption. Studies have confirmed that PYY is both necessary and sufficient to restore this critical function.[19]

The underlying mechanism is both elegant and precise. The small intestine must maintain a delicate electrochemical balance to power nutrient transport. Secretory hormones such as vasoactive intestinal peptide, released from enteric neurons, stimulate the secretion of ions and water into the gut lumen. PYY, acting in a local (paracrine) manner on adjacent enterocytes, counteracts this effect. By binding to its receptors (e.g., neuropeptide Y receptor Y1) and signaling through an inhibitory G-protein pathway, PYY lowers intracellular cyclic AMP levels. This action stabilizes the electrochemical gradients across the intestinal wall, which are required for ion-coupled nutrient transporters—such as sodium/glucose cotransporter 1—to function correctly. Without PYY, these gradients collapse, and nutrient absorption fails.

KINETICS AND METABOLISM OF L-CELL HORMONES (INCRETINS)

The release of GLP-1 and PYY is rapid following food ingestion. In humans, systemic circulating levels of both hormones increase within 15 minutes of a meal, with concentrations roughly proportional to the caloric content. After a mixed meal, plasma GLP-1 concentrations typically peak at approximately 40 minutes, while PYY peaks later, at approximately 90 minutes, before both reach a sustained plateau.[20,21] However, their persistence in circulation differs significantly due to their metabolic stability. GLP-1 has a very short half-life of approximately 2 minutes before it is rapidly degraded by the enzyme dipeptidyl peptidase-IV (DPP-IV).[22] PYY has a longer half-life of approximately 10 minutes but can remain in circulation for up to 6 hours postprandially due to a slower, more sustained release. It is also degraded by DPP-IV.[23] Oxyntomodulin has a half-life of 12 minutes, while glicentin's half-life is brief, as it is rapidly converted to oxyntomodulin.

METABOLIC SURGERY

Purpose of metabolic surgery

Metabolic surgery is designed to biologically enhance the hormonal effects of incretins, aiming for a state of "hypoabsorption" rather than inducing a crude malabsorptive state. This approach is justified by both biological and sociocultural factors. Biologically, following a meal, the plasma peaks of GLP-1 and PYY are delayed, occurring at 40 and 90 minutes, respectively.[24,25] This delay means that in the absence of other inhibitory signals, an individual may continue to eat for a considerable period before the powerful satiety signals from the ileal brake are activated. Metabolic surgery aims to shorten this delay.

From a sociocultural perspective, modern Western diets, rich in rapidly absorbed complex carbohydrates, have shifted nutrient absorption more proximally. These sugars are absorbed quickly in the jejunum and proximal ileum, leading to hyperstimulation of the endocrine cells in this region (e.g., I and K cells) and hypoactivation of the distal ileum. As Santoro *et al.*[26] proposed in his theory of proximal–distal intestinal imbalance, the intestine behaves like any other endocrine organ: chronic under-stimulation leads to reduced function. This results in a hormonal imbalance characterized by high levels of proximal gut hormones (e.g., GIP) and low levels of distal gut hormones (e.g., GLP-1 and PYY), contributing to the pathophysiology of obesity. Therefore, metabolic surgery seeks to correct this imbalance by accelerating the delivery of food to the distal ileum, thereby reactivating its endocrine function.

The rationale of sleeve gastrectomy with transit bipartition

The core principle of sleeve gastrectomy with transit bipartition is to expedite the delivery of the food bolus to the ileum to achieve a more rapid release of GLP-1 and PYY, thus inducing earlier satiety. This is accomplished through two synergistic mechanisms: accelerating gastric emptying via the sleeve gastrectomy component and bringing the ileum functionally closer via a gastroileal anas-

doi: 10.36922/sti.0280

tomosis. Pioneering work by Santoro *et al*.[26] demonstrated that this could be achieved without excluding any intestinal segments from transit, thereby preserving their hormonal function.

In this procedure, a sleeve gastrectomy is combined with an anastomosis between the gastric sleeve and the ileum, typically around 3 meters from the ileocecal valve. This creates a "bipartition" of transit: a portion of food passes directly into the ileum, while the remainder follows the natural path through the duodenum and jejunum. The goal is not to induce malabsorption but rather to promote a more distal absorption pattern, which is key to unlocking the endocrine potential of the ileum. This concept is supported by observations in patients with failing Roux-en-Y gastric bypass (RYGB) or one-anastomosis gastric bypass (OAGB), where therapeutic failure is often associated with a progressive decline in GLP-1 and PYY secretion over time, leading to increased appetite.[27] This highlights the principle that the intestine requires continuous stimulation to maintain its endocrine function.

Consideration of the definition of the procedure

The nomenclature for this class of procedures has been a subject of discussion. Terms such as sleeve gastrectomy with Roux-en-Y transit bipartition (RYTB), sleeve gastrectomy with one-anastomosis transit bipartition (OATB), and single anastomosis sleeve ileal (SASI) bipartition are often used. The term "bypass" is arguably inappropriate in this context, as the native gastroduodenal pathway is not completely bypassed but rather has its flow reduced (to approximately 25%). The term "transit bipartition" more accurately describes the dual pathways for food transit and the underlying physiology of the operation. The original procedure described by Santoro *et al*.[26] has been modified, notably by Mahdy *et al*.,[28] into a single-anastomosis loop configuration, which is often referred to as OATB or, more commonly but less precisely, SASI. For clarity and accuracy, "transit bipartition" is the preferred term.

Other mechanisms of transit bipartition

Beyond the rapid stimulation of L cells, transit bipartition leverages other physiological mechanisms. Bile acids, which are reabsorbed in the terminal ileum, stimulate ileal neuroendocrine cells to secrete fibroblast growth factor 19, a hormone that further enhances glucose metabolism.[29] Additionally, the increased nutrient load in the ileum stimulates the release of GLP-2, which induces ileal hypertrophy. This hypertrophy leads to a hyperproliferation of L cells, creating a positive feedback loop that enhances the endogenous secretion of GLP-1 and PYY over time, thereby amplifying the metabolic benefits of the surgery.[30]

TECHNICAL ASPECTS, OUTCOMES, AND COMPLICATIONS

The ideal bariatric surgery should be safe, technically simple, and effective in reducing weight and treating comorbidities.[31] The Santoro technique[32] was the basis of the transit loop bipartition.[26] This aims to facilitate the procedure and to minimize the risk of complications by reducing the number of anastomoses.[33] The first meta-analysis was published in July 2024.[34]

Advantages of transit bipartition/OATB/RYTB

Sleeve gastrectomy with transit bipartition/OATB/RYTB is a procedure that has been standardized worldwide following the World Consensus Meeting held in India in 2019.[35] It involves a side-to-side anastomosis located 2–6 cm from the pylorus between a sleeve calibrated on a 38–40 Fr tube, with the ileal loop located 300 cm from the ileocecal valve. Therefore, there are no antral or duodenal interruptions. If performed correctly, 75% of the food content continues the path in the efferent loop of the anastomosis, while 25% proceeds through the natural path (duodenum–jejunum–ileum).[32] This has a twofold advantage: the first is that all the L and K neuroendocrine cells of the food bolus's natural path will not lose their function, as food will be a source of continuous stimulation of their receptors and consequently of their specific hormones (see first part). The second advantage is that macro- and micro-nutrients contained in the approximately 25% of the food bolus that traverses the natural path can be absorbed through physiological mechanisms, thereby helping to preserve micronutrient homeostasis (e.g., see absorption and metabolism of iron). Consequently, malabsorption will be minimal. Notably, an overly wide anastomosis (>4 cm) bypasses the duodenum, leading to malabsorption. The meta-analysis by Oliveira *et al*.[34] showed that SASI bipartition demonstrated a remission of type II diabetes mellitus (T2DM) ranging from 78.6 to 100%, depending on the studies, with a median of 96.35%. This result was statistically superior compared to those of sleeve gastrectomy, RYGB, and OAGB. Regarding dyslipidemia, the one-year remission or improvement in patients who underwent SASI bipartition s varied from 65 to 100% with a median of 87.5%—a result superior to sleeve gastrectomy but comparable to OAGB. Regarding the resolution or improvement of hypertension one year after the SASI bipartition procedure, the results did not show significant differences compared to sleeve gastrectomy alone or OAGB (values varied between 35 and 100%, with a median of 75%). Regarding obstructive sleep apnea syndrome, the percentage of resolution varied from 20 to 100%—significantly superior compared to sleeve gastrectomy but comparable to OAGB. Regarding metabolic associated fatty liver disease, the studies were limited but reported resolution percentages between 73 and 95%. The median percentage of excess weight loss (%EWL) of those who underwent SASI bipartition at 12 months was 87.14%—a result close to the value reported by Mahdy *et al*.[33] The variation between the various studies was, however, between 63.9 and 94.5%. These values are higher than those of sleeve gastrectomy alone. The comparison data with OAGB were insufficient for meta-analysis. Nevertheless, the %EWL values are very close to those of a duodenal switch, which has a one-year %EWL of 70–85%, with some case series reaching 95%.[36] However, the SASI bipartition procedure is burdened by greater technical difficulties and a significantly higher risk of malabsorption. Six studies evaluated the effect of SASI bipartition on gastroesophageal reflux disease (GERD) and reported a median improvement or remission rate of 84.1%, ranging from 75 to 100%.[37–42] The protective mechanism is twofold: one issue of sleeve gastrectomy is the progressive intrathoracic migration over the years.[42] This occurs, albeit in lower percentages, despite the concomitant repair of hiatal hernia. A gastro-ileal anastomosis maintains the sleeve in place by gravity and represents one of the potential

doi: 10.36922/sti.0280

mechanisms capable of reducing reflux. The second mechanism that explains the resolution of gastroesophageal reflux is that the anastomosis represents an anatomical drainage of the sleeve, reducing intragastric pressure. Theoretically, a reduction in intragastric pressure could also reduce the risk of staple line fistula incidence, although this requires further large-scale studies. One of the undisputed advantages of the SASI bipartition procedure is endoscopic access to the stomach, duodenum, pancreas, and biliary tract, enabling diagnostic and therapeutic endoscopy when needed.[43–45] This feature is unique in its kind as procedures such as OAGB, RYGB, and single anastomosis duodeno-ileostomy with sleeve gastrectomy SADI-S make the aforementioned anatomical segments inaccessible, transforming a procedure on the biliary tract from an endoscopic procedure to a laparoscopic surgical procedure (in the best-case scenario). Primitive RYGB and OAGB also make the residual stomach unexplorable, making endoscopic control of upper digestive bleeding, diagnosis of dysplasia or gastric neoplasia, and gastric biopsy in general impossible.[46] In young subjects, therefore, it could have a significant meaning. Furthermore, even in the immediate postoperative period, total endoscopic access allows for any therapeutic intervention, including placement of endoscopic stents and pigtails, as well as operation of injectable or mechanical endoscopic hemostasis and dilations for stenoses. The complication of bile reflux, which is frequent and feared in OAGB procedures, is in fact negligible, as is the risk of marginal ulcer in OATB/RYTB.[46] However, even in cases of otherwise uncontrollable bile reflux, a Braun foot-of-loop anastomosis is sufficient to control the symptoms.[46] Another substantial consideration is the ease of reversibility of the SASI bipartition procedure in cases of an excessively wide anastomosis, malabsorption, excessive weight loss, or other complications. The conversion to sleeve gastrectomy involves resection of the anastomosis on the gastric side and creation of an entero-enteric (ileal) anastomosis. In cases of insufficient weight loss, the procedure can be readily converted to a SADI-S.[47] Another limitation is that creating two anastomoses instead of one inevitably prolongs operating time and increases the risk of related complications, such as anastomotic leaks, bleeding, and internal hernia. For a surgical technique to gain widespread adoption, it must be simple and reproducible. The original Santoro technique involves a double anastomosis to prevent bile reflux into the stomach. However, given the low incidence of bile reflux and marginal ulcers reported following OATB/RYTB, many authors suggest that the single anastomosis variant can be safely performed without significant issues. A 2023 study comparing the original Santoro technique to the Mahdy modified technique found that the latter was comparable to the original technique in resolving comorbidities and even superior in achieving %EWL at one year after the procedure, while reducing operative time and complications.[48] It should be noted, however, that the comparative study used a limited sample size and therefore requires further research. Unlike SADI-S, which is a risky procedure due to the duodenal anastomosis that could require an emergency duodenocephalopancreatectomy, OATB/RYTB has a much safer profile.

Medium-term outcomes

Medium-term data on transit bipartition are increasingly available and continue to support its efficacy. A 2023 study by Aghajani *et al*.[49] reported four-year follow-up data, demonstrating excellent and sustained weight loss without inducing significant malnutrition, as evidenced by stable albumin levels (**Table 1**, **Figure 2**). In the fourth year, the mean %EWL was 93.3% and the mean percentage of total weight loss (%TWL) was 41.2%. They also reported high rates of comorbidity resolution: complete remission of T2DM occurred in 93% of patients, hypertension in 73%, hyperlipidemia in 83%, and obstructive sleep apnea in 79% (**Table 2**). Notably, preoperative GERD was resolved or improved in 54% of patients, although 46% remained unchanged, and a small number developed *de novo* GERD.

A second, more recent meta-analysis published in September 2024, encompassing over 1,800 patients across 26 studies, reported similar short- to medium-term results.[50] At 36 months, the %EWL was 96.19% and the %TWL was 36.65%. Complete remission from T2DM at 12 months was 88.28%, and from hypertension was 74.04%. These consistent findings across multiple large-scale analyses strengthen the evidence base for the SASI bipartition procedure, although long-term studies with larger cohorts are still required.

Complications

An aggregate analysis of data from 15 publications, covering 1714 patients, revealed a manageable safety profile.[34] The overall rate of early complications (within 30 days) was 6.0%, while the rate of late complications was 5.6%. The perioperative mortality rate reported in a large series was 0.2%, a value comparable to other major bariatric procedures.

Early complications (within 30 days)

Complications in the immediate postoperative period are primarily related to the surgical technique. The most significant reported issues include anastomotic leaks, with an incidence of approximately 0.9%, which can originate from either the gastric staple line or the gastroileal anastomosis.[34] Postoperative bleeding requiring intervention and early intestinal sub-occlusion have also been recorded, with the latter occurring at an incidence of 0.8%. The meta-analysis by Ataya *et al*.[43] reported an overall early complication rate of 4.98%.

Late complications (after 30 days)

Late complications are varied. Intestinal obstruction is the most common late complication, with a reported incidence of 2.4%, often caused by adhesions or internal hernias.[43] Incisional hernias occurred in 3.1% of cases. Chronic diarrhea is also a frequently reported long-term side effect, potentially due to accelerated intestinal transit and altered bile salt absorption. The meta-analysis by Ataya *et al*.[43] found that late complications, including diarrhea, constipation, symptomatic cholelithiasis, and hypovitaminosis, occurred in 15.07% of patients.

Nutritional complications and need for revision

A critical and somewhat controversial aspect of transit bipartition concerns the risk of nutritional deficiencies. One publication reported a high aggregate incidence of 56% for "malnutrition and/or need for early bypass revision," suggesting a significant portion of patients may develop severe deficiencies.[51] However, this figure may be influenced by study heterogeneity. In contrast, other rigorous studies reported that severe protein malnutrition and chronic anemia are rare, attributing this to the preservation of the duodenal passage.[52,53] The meta-analysis by Ataya *et al*.[43] found that 2.12% of patients required surgical revi-

doi: 10.36922/sti.0280

Table 1. Weight loss outcomes and albumin levels over four years after a single anastomosis sleeve ileal bypass[43]

Time	Preoperative	3 months	1 year	2 years	3 years	4 years
Eligible (n)	366	356	257	150	81	49
Data available (n)	366	345	229	112	61	35
Follow-up (%)	–	97	89	75	75	71
BMI (kg/m2)	43.9 ± 6.6	35.4 ± 5.5	27.0 ± 4.3	25.9 ± 4.1	26.9 ± 4.6	26.3 ± 2.9
EWL (%)	–	47.9 ± 14.0	93.7 ± 21.8	110.5 ± 13.2	94.1 ± 19.0	93.3 ± 17.0
TWL (%)	–	19.5 ± 4.4	39.3 ± 6.9	42.2 ± 8.3	41.2 ± 9.9	41.2 ± 10.3
Albumin (g/dL)	4.3 ± 0.2	4.2 ± 0.3	4.2 ± 0.3	4.1 ± 0.3	4.1 ± 0.3	4.1 ± 0.2

Abbreviations: BMI: Body mass index; EWL: Excess weight loss; TWL: Total weight loss.

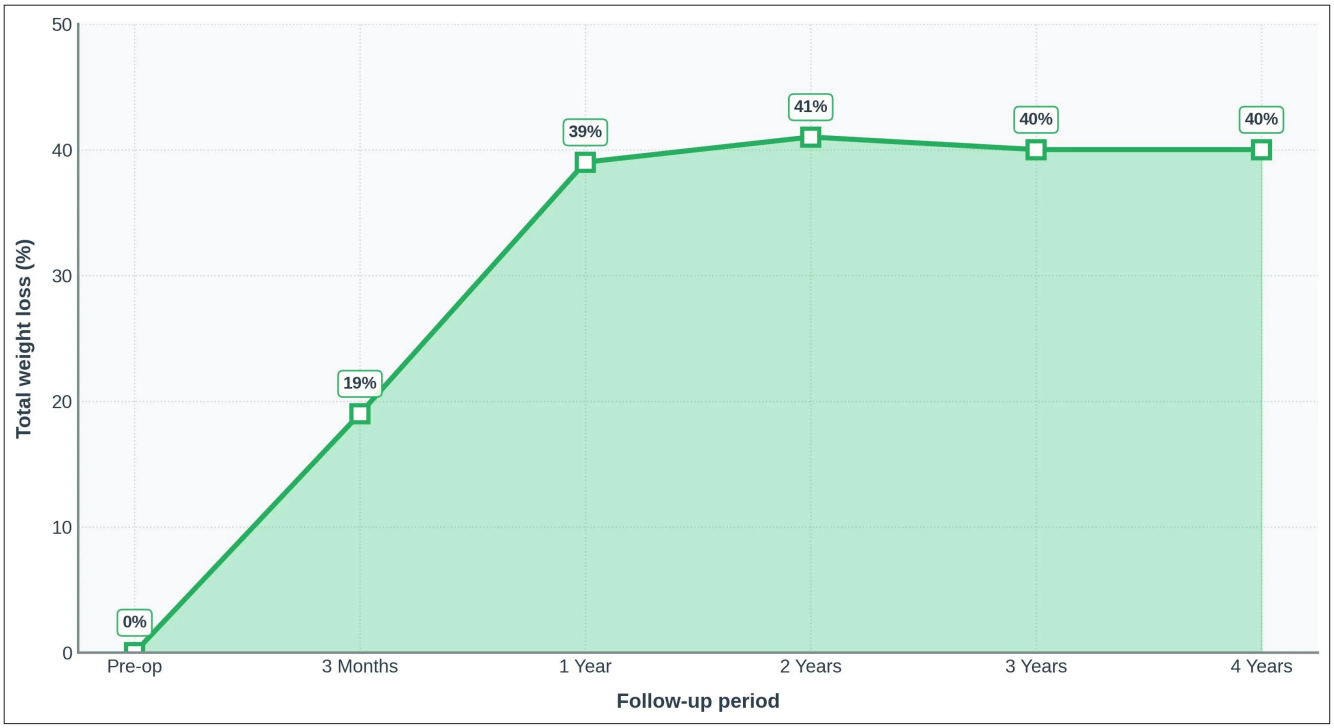

Figure 2. Weight loss outcomes (% total weight loss) over four years after a single anastomosis sleeve ileal bypass. Adapted from Aghajani *et al.*[48]

Table 2. Remission of comorbidities through four years after a single anastomosis sleeve ileal bypass[50]

Comorbidities	Preoperative (%)	Postoperative (%)		
		Resolved	Improved	Neutral
Type 2 diabetes mellitus	9.8	93.0	7.0	0
Hypertension	21.9	73.0	27.0	0
Hyperlipidemia	71.0	83.0	17.0	0
Obstructive sleep apnea	9.8	29.0	21.0	0
Gastroesophageal reflux disease	17.8	25.0	29.0	46.0

sion to sleeve gastrectomy due to hypoalbuminemia, malnutrition, or excessive weight loss, with an overall hypoalbuminemia rate of 4.95%.

This discrepancy highlights the critical importance of surgical technique. Subgroup analysis has shown that technical parameters significantly influence outcomes. A common limb length of 250 cm from the ileocecal valve was associated with greater weight loss and T2DM remission, but also a sharp

doi: 10.36922/sti.0280

increase in complications compared to a 300 cm limb. Similarly, a gastroileal anastomosis larger than 3 cm was linked to greater weight loss but a higher rate of late complications, particularly diarrhea (**Figure 3A & B**).[51] It appears that adhering to a 300 cm limb length and a 3 cm anastomosis size drastically reduces malabsorptive complications to less than 3%. It is important to note, however, that patient adherence to postoperative dietary and supplement regimens is a significant confounding factor that is often not well-documented in these studies.

Compared with other procedures, the risk of malabsorption appears relatively low and follows the gradient: biliopancreatic diversion with duodenal switch (BPS/DS) > SADI-S > RYGB > OATB/RYTB > sleeve gastrectomy.[52] However, even if it were to happen, supplementa-

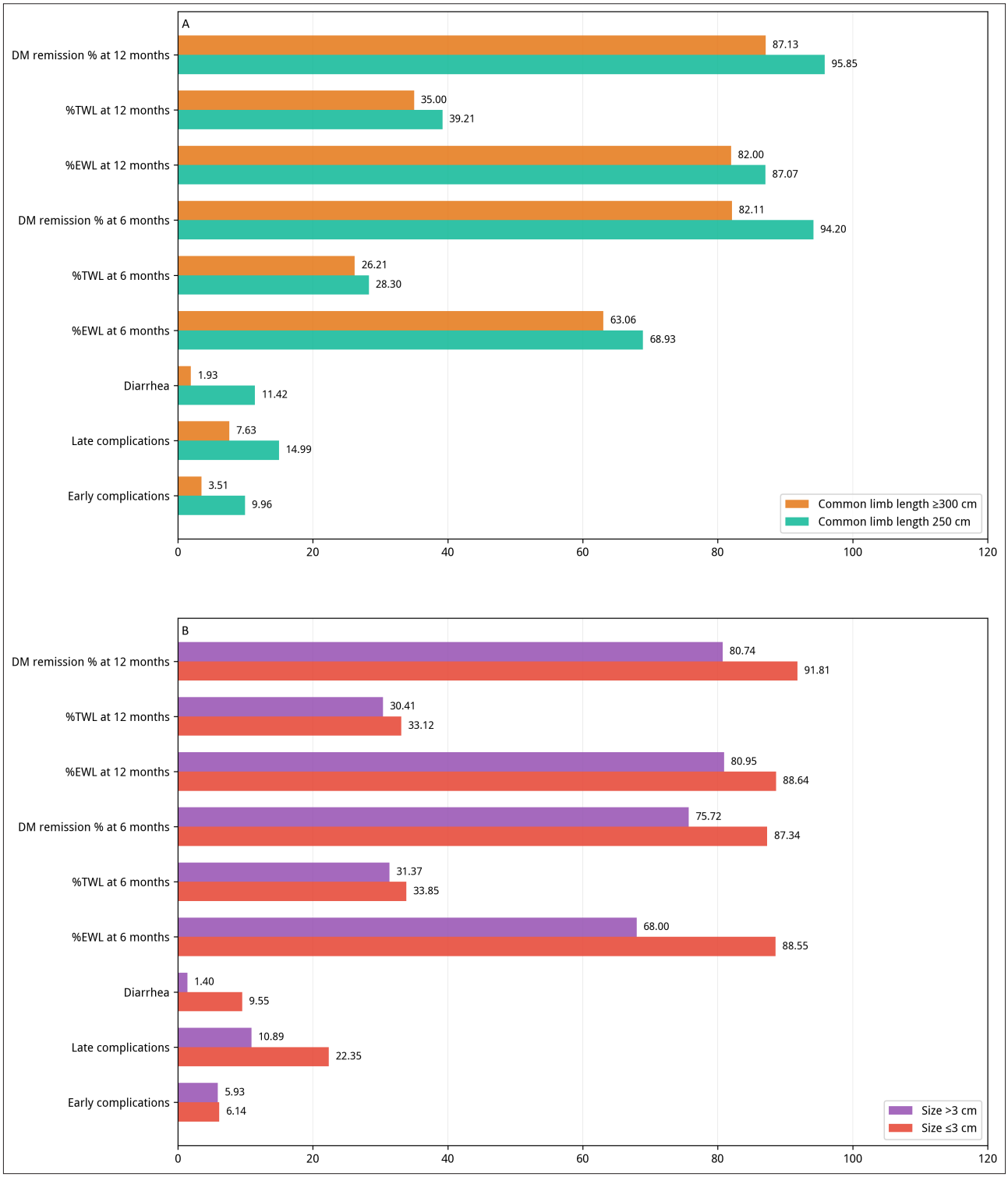

Figure 3. Comparison of outcomes and complications by (A) common limb length (250 cm vs. ≥300 cm) and (B) anastomosis size (≤3 cm vs. >3 cm). Adapted from Ataya et al.[43] Abbreviations: %EWL: percentage of excess weight loss; %TWL: percentage of total weight loss; DM: diabetes mellitus.

doi: 10.36922/sti.0280

tion with targeted micronutrients would be necessary, as is standard practice following other bariatric procedures. In the worst-case scenario, conversion to a simple sleeve gastrectomy may be necessary. In these cases, the procedure is considerably simpler than restoration after RYGB or OAGB, and especially after SADI-S or BPS/DS.

FINAL CONSIDERATIONS

Based on the available evidence, sleeve gastrectomy with transit bipartition (OATB/RYTB) emerges as a powerful metabolic procedure with a unique profile of benefits. It can be considered a valid therapeutic option in several clinical scenarios. It is particularly well-suited for patients with super-obesity, where a sleeve gastrectomy alone may not provide sufficient weight loss effects. Its superiority in resolving T2DM makes it an excellent choice for patients with obesity and diabetes, offering an alternative to more complex procedures such as SADI-S that involve higher-risk duodenal anastomoses. The preservation of full endoscopic access is a crucial advantage for patients who may require future surveillance or interventions of the biliary tract or remnant stomach, making it a compelling option for younger patients. Furthermore, it can be considered as a revision procedure for a failed sleeve gastrectomy or for patients with GERD who are hesitant to undergo an RYGB.

CONCLUSION

Based on the theoretical principles and scientific foundations explored to date, there are grounds to consider sleeve gastrectomy with transit bipartition (OATB/RYTB) a safe and effective procedure with an acceptable rate of complications in the short to medium term. Its strong physiological rationale, centered on enhancing endogenous incretin secretion without excluding intestinal segments, translates into potent metabolic effects and robust weight loss. While awaiting long-term results from larger, prospective trials, it is hoped that major scientific societies will consider introducing this procedure into the standard armamentarium of bariatric surgeons, following the example set by major Brazilian societies.[54]

AUTHORS' DISCLOSURE

None.

CONFLICT OF INTEREST

The authors declare that they have no relevant financial or non-financial interests to report.

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doi: 10.36922/sti.0280