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Study between Duodenojejunostomy and Roux-en-Y Gastrojejunostomy for Treatment of Superior Mesenteric Artery Syndrome: Meta Analysis

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Abstract

Background: Superior Mesenteric Artery (SMA) syndrome is a rare but serious condition characterized by the compression of the third portion of the duodenum, leading to symptoms such as abdominal pain, vomiting, and malnutrition. Surgical intervention is often required when conservative treatments are ineffective.

Aim of Study: To compare the outcomes of duodenojejunostomy and Roux-en-Y gastrojejunostomy in the treatment of SMA syndrome, focusing on their indications, efficacy, morbidity, and postoperative complications.

Patients and Methods: The study were conducted following PRISMA guidelines to compare the outcomes of duodenojejunostomy and Roux-en-Y gastrojejunostomy in patients diagnosed with Superior Mesenteric Artery (SMA) syndrome. The review included studies published in databases such as PubMed, Cochrane Library, and EMBASE. Studies were selected based on predefined inclusion and exclusion criteria, focusing on patients aged 13 to 60 years with confirmed SMA syndrome. Data extraction was independently performed by two reviewers, and the quality of the included studies was assessed using the Modified Cowley's criteria. Statistical analysis, including proportion meta-analysis, was conducted using Rstudio, with results synthesized quantitatively to evaluate the efficacy and safety of the surgical interventions.

Results: After screening 1083 articles, 38 were included in the qualitative synthesis, and 13 were included in the quantitative synthesis and meta-analysis. The pooled safety outcome for duodenojejunostomy in patients with superior mesenteric artery syndrome was 0.89 (95% CI: 0.81–0.94), with minimal heterogeneity (I^2=0%). Complications included angiostatin of the anastomosis, anastomotic edema, significant blood loss, and prolonged ileus. The pooled efficacy outcome was 0.84 (95% CI: 0.74–0.90), also with minimal heterogeneity (I^2=0%). Some studies reported persistent symptoms, including unresolved nausea, vomiting, and epigastric pain. Risk of bias across studies was low to moderate, with no significant publication bias detected (*p*-value >0.05).

Conclusion: Duodenojejunostomy is a generally effective and safe treatment for Superior Mesenteric Artery syndrome, with high efficacy and safety outcomes. However, some patients may experience persistent symptoms postoperatively. The study's findings are robust, with low to moderate risk of bias and no significant publication bias. Further research comparing duodenojejunostomy with Roux-en-Y gastrojejunostomy is recommended to determine the optimal surgical approach.

Key Words: *SMA syndrome – Duodenojejunostomy – Roux-en-Y gastrojejunostomy – PRISMA – Meta-analysis – Surgical outcomes – Postoperative complications.*

Introduction

SUPERIOR Mesenteric Artery (SMA) syndrome, also known as Wilkie's syndrome, is a rare cause of upper gastrointestinal obstruction resulting from the compression of the third part of the duodenum between the abdominal aorta and the SMA **[1]**. Initial complaints often include abdominal pain, nausea, vomiting, weight loss, and early satiety, which can complicate early diagnosis due to the nonspecific nature of these symptoms. Imaging plays a crucial role in diagnosis, with CT angiography being particularly effective in revealing the decreased aorto-mesenteric angle, which is indicative of duodenal obstruction **[2]**.

Superior mesenteric artery syndrome may be due to severe and rapid depletion of mesenteric fat caused by weight loss in high catabolic states such as anorexia nervosa, malabsorption, burns, and cancer. These conditions result in the reduction of the fat pad cushioning the duodenum, leading to

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its compression between the abdominal aorta and the SMA, which subsequently causes obstruction. This syndrome should be included in the differential diagnosis when there is an acute onset of nausea and vomiting in individuals with these medical conditions. Furthermore, SMA syndrome has been associated with neurological injuries resulting in spasticity, such as traumatic brain injury and cerebral palsy, which can further complicate the clinical presentation [3].

CT and magnetic resonance angiography (CTA/MRA) are essential tools for visualizing vascular compression of the duodenum and measuring the aortomesenteric distance, which are critical in diagnosing Superior Mesenteric Artery (SMA) syndrome. In this syndrome, rapid weight loss often results in a reduction of the aortomesenteric distance due to the depletion of intra-abdominal fat, particularly the duodenal fat pad. Normally, the aortomesenteric angle ranges from 28° to 65°, and the aortomesenteric distance spans from 10 to 34mm. However, in SMA syndrome, the SMA exits the abdominal aorta at an abnormally acute angle, typically less than 22–25°, and runs closer to the aorta, often within a distance of 2–8mm, depending on the patient's body mass index (BMI). It is crucial to recognize that no single measurement is definitively diagnostic, and imaging results must be carefully interpreted in conjunction with the patient's clinical history [4,5].

Conservative initial treatment is recommended in all patients with Superior Mesenteric Artery (SMA) syndrome, including adequate nutrition, nasogastric decompression, and proper positioning of the patient after eating (e.g., left lateral decubitus, prone, knee-to-chest position). Enteral feeding using a double-lumen nasojejunal tube passed distal to the obstruction under fluoroscopic assistance is an effective adjunct in the treatment of patients with rapid severe weight loss, and it also eliminates the need for intravenous fluids and the risks associated with total parenteral nutrition. In some instances, both enteral and parenteral nutritional support may be needed to provide optimal caloric intake. The patient's weight should be monitored daily [6,7].

Failure of medical therapy is an indication for surgical treatment in Superior Mesenteric Artery (SMA) syndrome. Several surgical approaches have been described, focusing on either mobilizing the duodenum out of the acute aorto-mesenteric window or bypassing the obstruction altogether. One of these approaches is the Strong procedure, which involves the release of the ligament of Treitz and the caudal mobilization of the distal duodenum to the right of the SMA. This technique, originally described as an open operation, has recently been successfully performed laparoscopically in pediatric patients [8]. While this method avoids the complications inherent to a bowel anastomosis, failure rates of approximately 25% have been reported, particularly in the pediatric population. The failure of this approach is often attributed to residual duodenal obstruction from branches of the inferior pancreaticoduodenal artery. As a result, better success rates have been reported with surgical bypass techniques, such as duodenojejunostomy, which are increasingly favored in complex cases [9].

Options for surgical bypass in SMA syndrome include a gastrojejunostomy or duodenojejunostomy. A gastrojejunostomy and side-to-side duodenojejunostomy at the second portion of the duodenum both allow enteric contents to bypass the obstructed portions of the duodenum. However, the obstructed duodenal segment distal to the bypass may function like a diverticulum and house static enteral contents. This stasis can result in residual symptoms in some patients via blind loop syndrome, gastric bile reflux, and foregut ulceration. Alternatively, a duodenojejunostomy at the third portion of the duodenum avoids these potential complications. Misdiagnosis of SMA syndrome could lead to severe complications such as electrolyte abnormalities and gastric perforation, with a mortality rate as high as 30% in affected cases. This makes it crucial for physicians to understand and consider this syndrome in their differential diagnosis [10].

By analyzing the advantages and potential complications inherent to both procedures, this research seeks to offer valuable insights that can guide clinical decision-making and optimize patient care for those affected by this rare and challenging condition.

Aim of the work:

The aim of the study is to compare and evaluate the indications, efficacy, morbidity and post operative complications of surgical options of treatment.

Patients and Methods

Research problem:

The research problem was defined by the PICO framework:

- P (Population): Patients diagnosed with Superior Mesenteric Artery Syndrome were considered.
- I (Intervention): Duodenojejunostomy was the primary intervention.
- C (Comparison): Roux-en-Y gastrojejunostomy served as the comparison.
- O (Outcome): The outcomes of interest included indications, efficacy, morbidity, and post-operative complications.

Study design:

A systematic review and meta-analysis were conducted following the PRISMA guidelines to compare the outcomes of duodenojejunostomy ver-

sus Roux-en-Y gastrojejunostomy in patients with SMA Syndrome.

Search Strategy and Identifying Relevant Publications:

Databases including PubMed, Cochrane Library, and EMBASE were searched for studies published up to the current year. Keywords and MeSH terms related to "Superior Mesenteric Artery Syndrome," "duodenojejunostomy," "Roux-en-Y gastrojejunostomy," and "surgical treatment" were utilized. Boolean operators (AND, OR) were employed to combine these terms in various ways, enhancing the search's breadth and specificity. Reference lists of included studies were reviewed for additional relevant publications.

Inclusion criteria:

Age Range: Patients aged 13 to 60 years. Diagnostic Confirmation: SMA Syndrome diagnosis confirmed through CT and Magnetic Resonance Angiography (MRA), showing vascular compression of the duodenum and specific aortomesenteric angle and distance measurements. The aortomesenteric angle normally ranges between (28-65) degrees and the distance between 10-34mm, whereas, for inclusion, these must be reduced, with angles of (6-22) degrees and distances of 2 to 8mm. Types of Studies: Prospective cohort studies, retrospective cohort studies, case-control studies, clinical trials, case series, and case reports. Human Studies: Only studies involving human participants. Published and Unpublished Studies: Including published papers, dissertations, conference proceedings, and registered clinical trials, regardless of publication status. Language: Studies published in English or those available with an English translation.

Exclusion criteria:

Unclear Diagnosis: Exclusion of studies where the diagnosis of SMA syndrome is ambiguous or not confirmed by the specified imaging techniques. Previous Major Upper GIT Surgery: Patients with a history of significant upper gastrointestinal surgery or gastric resection, as these conditions could affect the outcome of interest. Psychiatric Conditions: Exclusion of patients with psychiatric conditions like anorexia nervosa that could independently affect gastrointestinal function and outcomes. Animal Studies: Studies involving non-human subjects. Duplicate Data: Exclusion of studies reporting duplicate data from the same patient cohort to prevent redundancy and bias in data synthesis. Incomplete Data: Studies lacking comprehensive data on the outcomes of interest (efficacy, morbidity, and post-operative complications) relevant to the interventions compared.

Selection of the studies:

The systematic review process commenced with two trained reviewers conducting an independent screening of titles and abstracts derived from the initial database search, applying predetermined eligibility criteria to identify relevant studies. For records deemed potentially eligible, full-text articles were subsequently retrieved and scrutinized for definitive inclusion in the meta-analysis. The screening and selection process was meticulously documented, including reasons for exclusion at the full-text stage. In instances of disagreement between reviewers regarding study eligibility, resolution was achieved through comprehensive discussion, and if necessary, arbitration by a third, senior reviewer.

Quality assessment of methodology:

We conducted a thorough quality assessment of the included studies using the Modified Cowley's criteria. This approach ensured a detailed evaluation of each study's methodological soundness and the risk of bias, which is crucial for the integrity of our findings. The Modified Cowley's criteria are designed to address the unique challenges in assessing surgical intervention studies. Study was scored based on their reporting in 13 specific areas, with scores of 2 (satisfactory reporting), 1 (partial reporting), or 0 (no reporting).

Table (1): Modified Cowley's criteria.

Criteria	Score
Method of selection of patients identified and appropriate	
Number of patients deceased or lost to follow-up are either reported or included in appropriate statistical analysis	
Follow-up period, range and mean mentioned	
Scaffold/stent models specified (or interventional strategy)	
Well-defined criteria for outcomes measurement	
Valid statistical analysis undertaken	
Data mentioned for deceased individuals	
Age range and mean age stated	
Type of lesion stated	
Pre-operative diagnosis and percentages of patients given	
Quantification of outcomes	
Clinical outcomes reported at follow-up	
Independence of investigators (no conflict of interest)	

The total possible score was 26, with studies categorized based on their risk of bias: Low risk (24–26/26), moderate risk (20–23/26), and high risk (scores below 20/26, rendering them not eligible for inclusion) *[11]*.

Assessment process:

Dual Review: Two independent reviewers assessed each study using the Modified Cowley's criteria, resolving discrepancies through discussion or with a third reviewer *[11,12]*.

Scoring System: A scoring system was applied, awarding points for each criterion met, allowing for a comparative analysis of study quality.

Sensitivity Analysis: Conducted to compare outcomes from higher quality studies against the full set of included studies, testing the robustness of our findings.

Documentation and Transparency: Ensured full documentation of the quality assessment process, including individual study scores and a summary of findings.

Data extraction:

Data were extracted using a standardized form designed to ensure consistency and accuracy in capturing relevant study information. This form was developed specifically for the needs of the study and included various fields:

Data extraction was conducted independently by two reviewers to minimize bias and errors, with any discrepancies resolved through consensus or involvement of a third reviewer.

The standardized form included fields for:

Study Identification: Study ID, authors, year of publication, and source. Study Design: Type of study design (e.g., retrospective cohort, case report, case series) and country. Participant Characteristics: Total number of participants, age range and median, gender distribution, BMI, and other relevant demographic or clinical characteristics. Clinical Presentation: Symptoms reported, symptom duration, and any specific clinical presentations. Intervention Details: Surgical or medical intervention details, procedural duration, and technique variations. Outcome Measures: Short-term and long-term outcomes, complications, length of hospital stay, weight changes, and follow-up duration. Follow-Up: Duration from surgery to the latest follow-up, emergency department visits post-operation, and any post-operative complications or mortality.

Regular meetings facilitated the resolution of challenges, and extracted data were systematically organized for analysis using Rstudio, specifically the “meta” package for meta-analysis.

Types of interventions:

- Group A: Patients undergoing duodenojejunostomy.
- Group B: Patients undergoing Roux-en-Y gastrojejunostomy were categorized.

Pre-operative assessment:

Studies documented a full clinical history, clinical examination, routine pre-operative tests (complete blood count, coagulation profile, liver and kidney function tests, blood electrolytes), and any relevant imaging studies.

Study characteristics:

Included were sample size, location, study period, and follow-up duration.

Participant characteristics:

Participant characteristics were detailed across studies, focusing on demographics, clinical presentation, and baseline health status. Characteristics included total number of participants, age (median and range), gender distribution, Body Mass Index (BMI), and specific symptoms related to superior mesenteric artery syndrome such as pain, nausea, vomiting, and weight loss history. Additional clinical details such as the presence of prior surgeries, connective tissue disorders, psychological conditions like depression and anxiety, gastrointestinal disorders, and the history of nasojejunal tube feeding were also reported.

Outcome measures:

Outcome measures were quantitatively synthesized from the included studies, focusing on both safety and efficacy of duodenojejunostomy in patients with superior mesenteric artery syndrome. Safety outcomes were evaluated based on the prevalence of postoperative complications, including angiostatin of anastomosis, anastomotic edema, significant blood loss necessitating hemostasis, and development of postoperative prolonged ileus. Efficacy outcomes were assessed through patient improvement rates post-surgery, including resolution or significant reduction of symptoms such as vomiting, abdominal pain, and weight gain. These outcomes were reported as prevalence rates with corresponding 95% confidence intervals, derived using a fixed effect model.

Statistical analysis:

Statistical analysis was performed using Rstudio version 2023.12.1+402 “Ocean Storm” Release, specifically employing the “meta” package for meta-analysis. Proportion meta-analysis was conducted using logit transformation with the inverse variance method. Data from cohort and case series studies were synthesized quantitatively. Heterogeneity among the studies was evaluated using the I^2 statistic, with a predefined threshold of 50% to indicate significant heterogeneity. Additionally, a significant Chi-square value was used as a criterion for determining heterogeneity. In cases where significant heterogeneity was detected, a random effects model was applied; otherwise, a fixed effects model was utilized. To assess publication bias, funnel plots were visually inspected, and Egger’s test was used to determine the significance of bias. Results were reported as risk ratios for dichotomous data and mean differences for continuous data, each with 95% confidence intervals.

Results

Study characteristics:

The study characteristics are shown in Tables (2,3).

Risk of bias within studies:

Modified Cowley's criteria scoring (2: Satisfactory reporting, 1: Partial reporting, 0: No reporting).

1- Method of selection of patients identified and appropriate.
2- The number of patients deceased or lost to follow-up is either reported or included in appropriate statistical analysis.
3- Follow-up period, range and mean mentioned.
4- Scaffold/stent models specified (or interventional strategy).
5- Well-defined criteria for outcomes measurement.
6- Valid statistical analysis undertaken.
7- Data mentioned for deceased individuals.
8- Age range and mean age stated.
9- Type of lesion stated.
10- Pre-operative diagnosis and percentages of patients given.
11- Quantification of outcomes.
12- Clinical outcomes reported at follow-up.
13- Independence of investigators (no conflict of interest)

Total scores:

- Low risk of bias: 24–26/26.
- Moderate risk of bias: 20–23/26.
- High risk of bias (not eligible for inclusion): <20/26.

Synthesis of results:

Safety:

The pooled safety outcomes for duodenojejunostomy among patients with superior mesenteric artery syndrome, based on 13 studies, yielded a prevalence of 0.89, with a 95% confidence interval (95% CI) ranging from 0.81 to 0.94 using a fixed effect model (I^2=0%). Among these studies, Tong Zhang's 2014 study reported angiostatin of the anastomosis in one patient and anastomotic edema in another out of a total of 10 patients. Charles Fredericks' 2016 study documented significant blood loss (300 ml) necessitating hemostasis in one patient. Chang's 2016 study reported that 2 patients developed postoperative prolonged ileus.

Efficacy:

The pooled efficacy outcomes for duodenojejunostomy among patients with superior mesenteric artery syndrome, synthesized from 13 studies, revealed a prevalence of 0.84, with a 95% CI (0.74 – 0.90) using a fixed effect model (I^2=0%). Individually, Rebecca Wyten's 2010 study found unresolved symptoms in one out of three patients. Charles Fredericks' 2016 study reported improvement in two out of three patients, with uncertainty surrounding the outcome of the third case. Sabry's 2022 study indicated occasional vomiting and abdominal pain in one out of eleven patients. Sun's 2014 study highlighted persistent symptoms in three out of fourteen patients during follow-up, with two experiencing ongoing nausea and vomiting and one reporting less severe symptoms but persistent epigastric pain. Chang's 2016 study reported that fourteen of 18 patients had initial improvement. However, at the latest follow-up, only 6 patients reported symptomatic improvement.

Risk of bias across studies:

Publication bias:

The visual inspection of funnel plots suggests approximate symmetry for both safety and efficacy funnel plots. Egger's test indicates symmetric funnel plots with no evidence of publication bias (*p*-value >0.05).

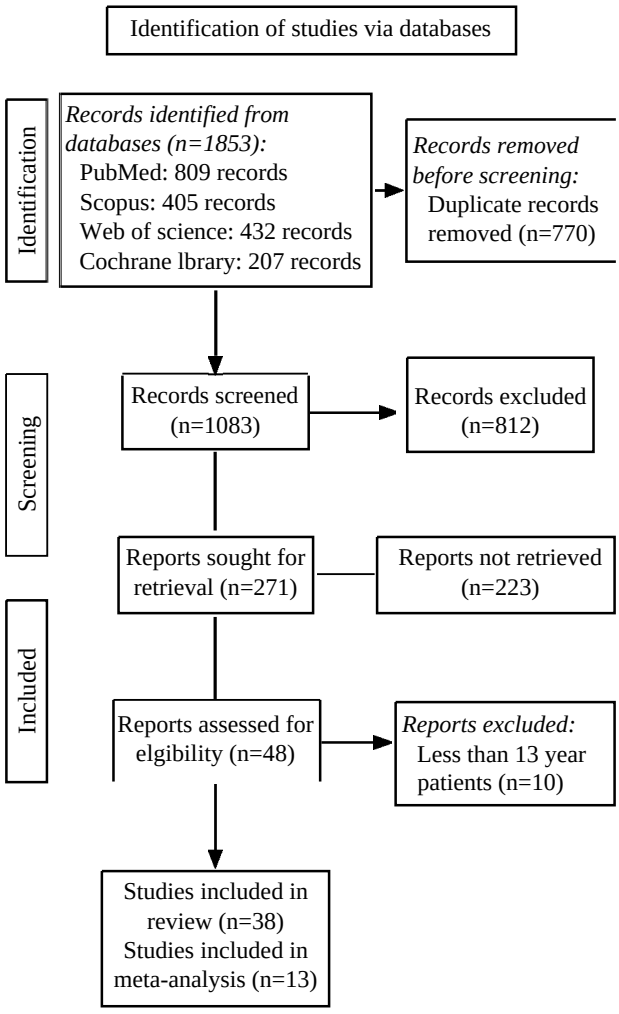

Fig. (1): PRISMA flow diagram.

Table (2): Characteristics of the duodenojejunostomy studies.

Study ID	Design, Country	Patient characteristics	SMA characteristics	Clinical presentation	Short-term outcomes	Follow-up
Carrinton A. 2023	Retrospective cohort, USA	Total=8, Age: Median 16 (14.8 – 17.3), Females: 100% Weight: 53.1 (47.2 – 58.8), Height: 1.6 (1.57 – 1.68), BMI: 19.8 (19.1 – 20.6).	AM angle: 14.7 (12.4 – 17.3) AM distance: 4.05 (3.03 – 5.75)	Symptom duration: 10 (8 – 14). Pain: 88% Nausea: 75% Vomiting: 63% History of Weight Loss: 50% History of Prior Surgery: 25% History of Migraine: 38% History of Connective Tissue Disorder: 38% History of Depression: 38% History of Anxiety: 38% History of GI Disorder: 63% History of Endoscopy: 63% History of Nasojejunal Tube Feeding: 63%	Procedure Duration, min 259 (182.0 – 315.3). Length of Stay, days: 4 (2.00 – 9.25).	Post-Operative Weight Gain, kg 1.6 (3.08- 0.75). Difference Between Ideal and Post-Operative Weights, kg 3.13 (1.45 – 5.05). Time from Surgery to Latest Follow-Up, days 37 (22 – 73). Time from Surgery to Last Emergency Department Presentation, days 48 (34 – 60). Number of Post-Operative Emergency Department Presentations 1.5 (0 – 2).
James M. Prieto. 2021	Case report, USA	Total: 1 Age: 13 years Sex: Male	AM angle = 12	Severe stomach pain accompanied by episodes of bilious vomiting.	Length of Stay, days: 7 (5 days NPO and 2 days on diet)	18 months without obstructive symptoms
Tong Zhang. 2014	Case series	Total: 19 Age, mean ± SD: 30.4±11.0 Female: 68.4%	AM angle: 15.3 (8.7–20.4) AM distance: 0.45 (0.35–0.8) cm	Postprandial nausea and vomiting: 63.2% Epigastric pain: 57.9% Postprandial fullness: 42.1% Early satiety: 36.8% Depression: 10.5% Endoscopic findings Bile reflux gastritis: 84.2% Peptic ulcer: 15.8%	The operation lasted 1.5 to 3.5 hours (median, 2 hours), with blood loss 30 to 100 mL (median, 75 mL).	Angiostaxis of anastomosis in 1 patient Anastomotic edema in 1 patient. There was no leak in the 19 cases one month after the operation. Postoperative body weight increased after 6 months.
Baraa K Alnabulsi. 2011	Case report	Total: 1 Age: 24 years Sex: Female Total: 1		4-year history of vague abdominal pain, mainly at the epigastric region, radiating to the back, associated with heartburn, repeated vomiting, and significant loss of weight during the previous 6 months.		No leak and a patent anastomosis
Chao Yan. 2016	Case report	Age: 57 years Sex: Male	AM angle: 25 AM distance: 7.8 mm	1-year history of cough. The patient began to suffer heartburn, regurgitation, nausea, bloating, and vomiting 3 years ago. Acid could reflux to his mouth sometimes. He had a 5-kg weight loss during a period of 2 years. BMI = 19.3	The operation lasted approximately 4 hours. The patient was discharged from the hospital on the 10th day after the operation without any complications	The patient achieved complete relief of symptoms and discontinuation of the drugs 1 year after operation
Akira Umemura 2022	Case report	Total: 1 Age: 24 years Sex: Female	AM angle: 11 AM distance: 4.5 mm	Weight loss from 42 kg to 27 kg within 6 months. Postprandial abdominal pain.	The operating time and blood loss were 160 min and 4 mL, respectively.	The patient was dicharged on postoperative day 6, who then gained 4 kg within 2 months of discharge. In addition, she has never complained of her preoperative severe symptoms such as postprandial pain and anorexia after discharge.
FJ Bohanon 2016	Case series	Total: 2 Age: Case1 and 2 were 17 years old Sex: Female	AM angle: Case 1: 15 degree	Case 1: abdominal pain associated with nausea and non-bilious vomiting. Anorexia nervosa for a period of six years with a BMI of 14 at the lowest point. Case 2: abdominal pain, nausea, decreased PO intake, dehydration, and non-bilious vomiting.	Case 1 was dicharged home on hospital day 5. Case 2 was discharged home on hospital day 7.	Case 1: She was gaining weight and having no concerns or complications after the resolution of the SMAS. Case 2: she has been gaining weight and tolerating feeds without any complications.

Table (2): Count.

Study ID	Design, Country	Patient characteristics	SMA characteristics	Clinical presentation	Short-term outcomes	Follow-up
Hatem Saber 2023	Case series	Total: 6 Age: Median (18 years), Range (17 – 31) Sex: 1 Male and 5 Female			Median hospital stay was 7 days, and no in-hospital/ 30-day post-operative mortality or complications were identified.	No recurrence of symptoms and a BMI median increase of 10.2 (range 8-13.6) at a median follow-up of 18 months (range 12-30 months)
Subhashini 2011	Case report	Total: 1 Age: 39 years Sex: Male		Upper GI obstruction and distended abdomen	The operating time was 120 min, and minimal blood loss.	Tolerate oral diet well. At her 2-week follow-up visit, she had a very good appetite and no post-prandial epigastric pain but still had loose bowel movements.
Gregory Magee 2011	Case report	Total: 1 Age: 81 years Sex: Female		Recurrent post-prandial abdominal pain, early satiety, diarrhea, and weight loss. Her past history was significant for documented mesenteric ischemia, requiring multiple attempts of SMA angioplasty and stenting 6 years prior to presentation	An upper GI study on postoperative day 4 showed good patency of the anastomosis. She was discharged home on postoperative day 5, tolerating a regular diet.	At her 3-month follow-up visit, she remained asymptomatic and was starting to gain weight.
Akira Yoneda 2019	Case report	Total: 1 Age: 72 years Sex: Female	AM angle: 21.6	Chronic renal failure presented with nausea, vomiting, and weight loss.	The patient started a diet on postoperative day 7.	She remained well with normal oral intake at the 1-year follow-up. Weight recovery and performance status improvement were observed during this time.
Rebecca Wyten 2010	Case series	Total: 3 Age: 41, 28, 36 years Sex: Female, male, male	AM angle: NA, 20, 17	Case 1: acute history of right upper quadrant pain. Nausea, vomiting, and fever. Case 2: 10-year history of recurrent episodes of sub umbilical pain, sweating, fullness, vomiting up to two meals at a time, weight loss of over 12 kg over 10 years, and explosive diarrhea. Case 3: 13-year history of severe daily periumbilical abdominal pain, bloating, and flatulence, with occasional episodes of vomiting if the pain was prolonged. He had progressive weight loss because of poor intake due to postprandial pain and was 50 kg prior to surgery.	Case 1: Operative time was 1 hour and 35 minutes. The patient recovered uneventfully and was discharged home on postoperative day 5. Case 2: The operative time was 3.5 hours. The patient's recovery was uneventful, and he discharged himself 4 days post-surgery. Case 3: The procedure time was 2 hours. The patient was discharged on day 4.	Case 1: During the acute period prior to surgery, she lost 4 kg in weight, but this returned to 51 kg in 2 months postoperatively On follow-up, the patient has remained symptom-free 2.5 years post-surgery. Case 2: On follow-up 5 years later, his symptoms have not recurred, and his weight had increased from 61 preoperatively to 75 kg. Case 3: Since his operation 7 years ago, the patient has gained significant weight to approximately 62 kg. His symptoms, although not completely resolved, are significantly less severe.
Andreana Butter 2010	Case report	Total: 1 Age: 16 years Sex: Female	SAM angle < 20 AM distance < 8 mm	18-month history of severe post-prandial epigastric pain, nausea, anorexia, and weight loss.	The patient recovered uneventfully and was discharged home on postoperative day 3	Her post-prandial pain resolved completely. She gained 1.4 kg by her one-month postop visit. At 21 months postop, she remains completely asymptomatic and has maintained a total weight gain of 3.2 kg.

Table (2): Count.

Study ID	Design, Country	Patient characteristics	SMA characteristics	Clinical presentation	Short-term outcomes	Follow-up
Charles Fredericks 2016	Case series	Total: 3 Age: mean = 35.3 years Sex: 2 Females, male		The indications were abdominal pain in all three patients	The average estimated blood loss (EBL) was 50 mL for two patients. One patient had EBL of 300 mL from bleeding omentum requiring additional hemostasis. The mean hospital length of stay was 3.67 days.	Obstructive symptoms were improved in two patients at the six-month follow-up and one patient was lost to follow-up
Jason D. Fraser 2009	Case report	Total: 1 Age: 32 years Sex: Fem	AM distance = 7.2 mm	5-year history of vague epigastric pain that intermittently radiated to the back. Weight loss.	A swallow study performed on postoperative day 1 revealed no evidence of leakage or stenosis, and the patient was started on a clear liquid diet and advanced to pureed foods over the next 2 days prior to discharge on day 3.	On follow-up, the patient denies pain and nausea and enjoys a regular diet without symptoms.
Jaw-Wen Chen [9]	Case series	Total: 2 Age: 45, 44 years Sex: Females	AM angle: 19.6, 14.7	Case 1: abdominal pain over the past two years and a concomitant sixty-pound weight loss that was unintentional. Case 2: Abdominal pain, weight loss, nausea, and vomiting. She also suffered from chronic diarrhea.		Case 1: She recovered 30 pounds of weight over a six-month period. She was also able to tolerate full meals without any postprandial vomiting. Case 2: Her two-year follow-up showed complete resolution of her upper GI symptoms.
Rebeca Heidbreder 2018	Case report	Total: 1 Age: 20 years Sex: Female		Sudden onset severe left flank and lower left quadrant (LLQ) abdominal pain, nausea, and vomiting.		Eight months after the Roux-en-Y duodenojejunostomy, a CT showed patent anastomoses, a reduction in thenumber of pelvic varices, and a reduced diameter of her ovarian vein. She was able to eat with minimal GI disturbance and had regained 5 kg.
LSKKP Maduranga 2022	Case report	Total: 1 Age: 23 years Sex: Female		Repeated episodes of abdominal pain and bilious vomiting for 5 months duration. Vomiting was postprandial, occurring about 30-45 minutes after each meal, which occurred more with liquid diets. She has experienced 11 kg weight loss during the past 5 months.	The patient was able to tolerate oral feeds from postoperative day 4. We were able to discharge the patient after 6 days of the surgery without any significant complications.	
Keith S. Gersin 1998	Case report	Total: 1 Age: 24 years Sex: Female		Nausea, bilious vomiting and a recent 20 pound weight loss	A diet was begun over the next 36 hours. She was discharged home on postoperative day 4 without complications, tolerating a regular diet.	

Table (2): Count.

Study ID	Design, Country	Patient characteristics	SMA characteristics	Clinical presentation	Short-term outcomes	Follow-up
Julietta Chang 2016	Retrospective cohort	Total: 18 Age: Mean 31.1 years. Sex: 4 Males, 14 Females	Narrowed aortomesenteric angle (14 of 18 patients	Abdominal pain (100%), nausea/vomiting (88.9%), weight loss (55.5%), mean BMI (19.9 kg/m^2), mean weight loss (14 kg).	The average operative time was 143.9 min, and the average estimated blood loss was 21.4 mL. Postoperatively, 2 patients developed prolonged ileus, and 1 required post-operative TPN supplementation.	Eighteen patients were available for intermediate follow-up defined as at least 6-month follow-up with an average and median length of follow-up was 27.7 and 26.0 months, respectively. Patients gained an average of 2.2 kg with an increase in body mass index of from 19.6 to 20.4 m/kg 2. Fourteen of 18 patients reported initial improvement of symptoms
Reyaz 2009	Case report	Total: 1 Age: 66 years Sex: Male	AM angle: 8.6	Severe upper abdominal pain and distension that had been present for a few days. He had no history of nausea, vomiting, recent weight loss, altered bowel habits, or previous abdominal surgery.	He tolerated oral feeds and diet and was discharged on the seventh postoperative day.	The patient remained well and asymptomatic during follow-up at 1 and 3 months.
Palanivelu 2006	Case report	Total: 1 Age: 14 years Sex: Male		Chronic upper abdominal symptoms for 10 years, ie, epigastric pain, nausea, voluminous vomiting (bilious and partially digested food), postprandial discomfort, and early satiety.	A liquid diet was started from the second POD and a solid diet from the fourth POD. The patient was discharged on the fifth POD.	Gastrografin swallow was done 6 months after surgery, and no hold-up of contrast occurred. There is no recurrence of symptoms so far.
MUNENE 2007	Case report	Total: 1 Age: 33 years Sex: Female	AM angle: 30	Presented with a 1 week history of epigastric abdominal pain exacerbated with oral intake and associated with multiple episodes of emesis.	Total operative time was 110 minutes. Post-operatively, the diet was advanced on postop day number 1, and she was discharged on postop day number 4.	
Kirby 2017	Case series	Total: 4 Age: 17, 45, 21, 69 years Sex: One male and 3 females	AM angle: 34, 18, NA, NA AM distance: 3.4, 7, 7, 8 mm	Case 1: Epigastric pain, bloating and a prolonged history of vomiting. Case 2: Epigastric pain and vomiting Case 3: Daily, frequent vomiting and the need to lie on her left side for comfort after eating. Case 4: episodes of postprandial epigastric pain, and nausea without vomiting.	Case 1: He was discharged without complication after 5 days. Case 2: the patient was discharged after one day Case 3: She was discharged after seven days Case 4: She was discharged from hospital after seven days.	Case 1: At a 40-week follow-up, he had not vomited and was able to tolerate normal diet without symptoms. His BMI had increased to 19.1. Case 2: she did report some postprandial discomfort at clinical follow-up 29 weeks postoperatively. A barium study showed a patent duodenojejunostomy, with no contrast passing D3. Her BMI remained at 19. Case 3: Initially, all symptoms resolved and she was well for several months, but after seven months her vomiting returned, accompanied by postprandial diarrhea. At 62 weeks follow-up, her BMI was 15.8 (no change) Case 4: At a four-week follow-up, the patient had made a full recovery with resolution of abdominal pain and an appetite much improved. Her BMI was 15 (baseline was 16.2)

Table (2): Count.

Study ID	Design, Country	Patient characteristics	SMA characteristics	Clinical presentation	Short-term outcomes	Follow-up
Barkhatov 2017	Case series	Total: 5 Age: Range 14-33 Sex: Females	AM angle: Range 10 – 20		No intraoperative unfavorable incidents were reported. Median operative time was 95 (range 91 – 110) min. No measurable bleeding beyond the suction tube (considered to contain < 50 mL) was detected. The postoperative course for every patient was uneventful, and the patients started to drink and eat during the day of the surgery. The median postoperative hospital stay was 1 (range 1 – 2) day.	Patients were observed during a follow-up period of 1 –5 years. Postoperative median restoration of the weight was 5 (range 0 – 8) kg, and the corresponding median improvement of BMI index was 1.8 (range 0 – 2.8).
Sabry [10]	Case series	Total: 11 Age: 23 years (range 17–43 years) Sex: 10 Females and one male	AM angle < 25, median 21° (range 13–28°).	Duration of symptoms ranged from 12 to 60 months, median 18 months. All patients presented with symptoms of vomiting (n = 11, 100%), and all except one presented with abdominal pain (n =10, 90.9%). Median BMI was 19 kg/m^2 (range 15–27 kg/m^2)	Operative time ranged from 125 to 285 minutes, and a median operative time of 160 minutes. The median recorded blood loss was 70 ml (range 50–160 mls)	Median follow-up was 16 months (range 4–48 months). Ten out of the eleven patients (n =10, 91%) have experienced improvement of their symptoms postoperative, with 8 patients (73%) having complete resolution and no recurrence of symptoms at the latest follow-up appointment. One patient reported occasional vomiting, and another had recurrent abdominal pain at follow-up. Only one patient did not have significant symptomatic improvement after 16 months of follow-up despite achieving some weight gain (BMI increase of 1.2). All patients gained weight postoperatively. Median BMI improved by 2 kg/m 2 (range 1–9 kg/m 2). No postoperative complications, readmission, or mortality were recorded.
Kim 2003	Case series	Total: 2 Age: 27 and 36 years. Sex: One female and one male		Severe abdominal pain and weight loss	Both cases were discharged without complications.	12 months follow-up: no complication, and they were on a regular diet and gained weight.
Sun 2014	Case series	Total: 14 Age: mean 39 (range 19–91 years) Sex: 11 females, 3 males	AM angle < 25	Persistent nausea (86 %), vomiting (79 %), epigastric pain (93 %), bloating (14 %), and esophageal reflux (21%). The symptoms were chronic, with the length of symptoms ranging from 3 to 48 months (mean 24 months) before surgery. All patients had weight loss from the development of symptoms to surgery ranging from 3 to 30 kg (mean 10.7 kg). The mean preoperative body mass index (BMI) was 19.9 kg/m^2 (range 14.5–28 kg/m^2).		Duration of follow-up: mean 20 months. All patients reported symptom improvement immediately after surgery. At a mean follow-up of 20 months, durable symptom improvement was achieved in 11 patients (79 %), while two patients still noted nausea and vomiting. One patient had less severe nausea and vomiting than before, but epigastric pain was still persistent. The mean weight gain of this group was 3.8 kg (0–10.7 kg, $p<0.01$) at the last visit. The mean BMI gain of all patients was 1.38 kg/m^2 (range 0–4.2 kg/m2, $p=0.37$).

Table (3): Characteristics of the gastrojejunostomy studies.

Study ID	Design, Country	Patient characteristics	SMA characteristics	Clinical presentation	Short-term outcomes	Follow-up
Bronswijk Michiel 2021	Case report	Total: 1 Age: 88 years Sex: Male	AM angle: 9.1	vomiting, anorexia, and upper abdominal pain. He had lost 10 kilograms over the course of 4 months as a result.	No complications occurred and the patient was started on clear liquids the same evening. During the following days, intake increased progressively and the patient was discharged on day 7.	
Andrew C. Storm 2022	Case report	Total: 1 Age: 19 years Sex: Male		Symptoms of shortness of breath and syncope associated with significant and rapid weight loss of 26.2% total body weight loss within 3 months. Tissue biopsy confirmed the diagnosis of diffuse large B-cell lymphoma, and chemotherapy was initiated.	Within 24 hours, the patient was tolerating a full liquid diet and was discharged 9 days later on a low-residue mechanical soft diet. He continued to lose weight, reaching a nadir of 46.1 kg.	One month later, the patient developed epigastric and right upper quadrant pain. A hepatobiliary iminodiacetic acid scan demonstrating bile reflux into the stomach ruled out cholecystitis, and the patient was treated conservatively with ursodiol. The follow-up upper gastrointestinal (GI) series showed a widely invasive gastroenterostomy during the same visit. Four months after LAMS placement, an upper GI series showed a patent gastroenterostomy. Six months after LAMS placement, the patient gained sufficient weight, reaching a weight of 54.9 kg
Lauren Raff 2023	Case report	Total: 1 Age: 33 years Sex: Female		A 1-year history of intermittent right upper quadrant abdominal pain, bloating, nausea, and nonvolitional bilious vomiting shortly after food consumption. Severely underweight (body mass index 13.45 kg/m^2)	After demonstrating the ability to tolerate a regular diet consistently, she was discharged home with plans for ongoing close outpatient follow-up.	
Ming-ming Xu [5]	Case report	Total: 1 Age: 32 years Sex: Female		A 7-month history of Progressive abdominal discomfort, post-prandial nausea, poor appetite, emesis, and inability to maintain per-oral diet. She reported unintentional weight loss of 15.9 kg. She weighed 42.4 kg with a body mass index of 14 kg/m 2 at the presentation time.		At 2 2-month follow-up, the patient reported tolerating a stent diet, resulting in a 4.5 kg weight gain.
Kubo 2019	Case report	Total: 1 Age: 58 years Sex: Female	AM angle = 16	2 days of vomiting.	The patient stopped vomiting and could receive nutrition.	
Hideaki Kawabata 2019	Case report	Total: 1 Age: 89 years Sex: Female	AM angle = 14 AM distance = 5 mm	A 3-day history of repeated vomiting since her admission. Examination revealed a BMI of 17.7 kg/m2 and abdominal distension without tenderness.	The patient then started direct swallowing training.	She has been asymptomatic in 1 month since anastomosis although slight anastomotic stricture was confirmed endoscopically.
David Jonason 2023	Case report	Total: 1 Age: 77 years Sex: Male		The patient developed new abdominal pain, distention and nausea 1 day following surgical revision of a C8-T2 cervical spine fusion.	The procedure went without complications. He subsequently tolerated gradual diet advancement.	He is now gaining weight.

Table (3): Count.

Study ID	Design, Country	Patient characteristics	SMA characteristics	Clinical presentation	Short-term outcomes	Follow-up
Sneha Shaha 2021	Case report	Total: 1 Age: 61 years Sex: Male	AM angle = 20	A week of diffuse abdominal pain associated with nausea, vomiting, anorexia, and constipation after a 25 pound weight loss.	He recovered well with the gastric venting via G-port and enteral nutrition via J-port.	Two months later, another EGD showed complete resolution of the obstruction, and G-J tube was pulled out. Patient has maintained adequate oral feeding with steady weight gain.
Kimura 2022	Case report	Total: 1 Age: 64 years Sex: Male	AM angle = 18 AM distance = 8 mm	Appetite loss and vomiting.	His nutritional condition was slightly improved. On the first post-opeative day, the patient was commenced on oral fluid intake and pureed food by the second day.	We perform the exchange of the gastrostomy every 6 months and there is no evidence of gastric dilatation on the radiographic image. There have since been no problems with the gastrostomy or evidence of recurrence of SMA syndrome.
Chung **[7]**	Case report	Total: 1 Age: 78 years Sex: Female		Worsening upper abdominal pain and profuse vomiting for several days. Interestingly, the patient described being frightened to eat as the pain was significantly worse during meal-times. BMI = 19 Kg/m^2	On the seventh day, the patient's condition was deemed suitable for discharge.	Outpatient clinic review at three months confirmed she had made a full recovery and improved her nutritional status, increasing her BMI from 19 kg/m^2 to 22.5 kg/m^2. The patient required no further surgical input and was subsequently discharged.

Table (4): Risk of bias assessment using Modified Cowley's criteria scoring.

Items Study ID	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11	Q12	Q13	Total	Risk of bias
Carrinton A. 2023	2	2	2	2	2	1	2	2	2	2	2	2	2	25	Low
Tong Zhang 2014	2	2	2	2	2	1	2	2	2	2	2	2	2	25	Low
FJ Bohanon 2016	2	2	1	1	2	0	2	2	2	2	2	1	2	21	Moderate
Hatem Saber 2023	2	2	2	1	2	1	2	2	2	2	2	2	2	24	Low
Rebecca Wyten 2010	2	2	2	1	2	1	2	2	1	2	2	2	2	23	Moderate
Charles Fredericks 2016	2	2	2	1	2	1	0	2	1	2	2	2	2	21	Moderate
Jaw-Wen Chen **[9]**	2	2	2	2	2	1	2	2	2	2	2	2	2	25	Low
Julietta Chang 2016	2	2	2	2	2	2	2	2	2	2	2	2	2	26	Low
Kirby 2017	2	2	2	2	2	2	2	2	2	2	2	2	2	26	Low
Barkhatov 2017	2	2	2	2	2	2	2	2	2	1	2	2	2	25	Low
Sabry **[10]**	2	2	2	2	2	2	2	2	2	2	2	2	2	26	Low
Kim 2003	2	2	2	2	2	2	2	2	2	1	2	2	2	25	Low
Sun 2014	2	2	2	2	2	1	2	2	2	2	2	2	2	25	Low

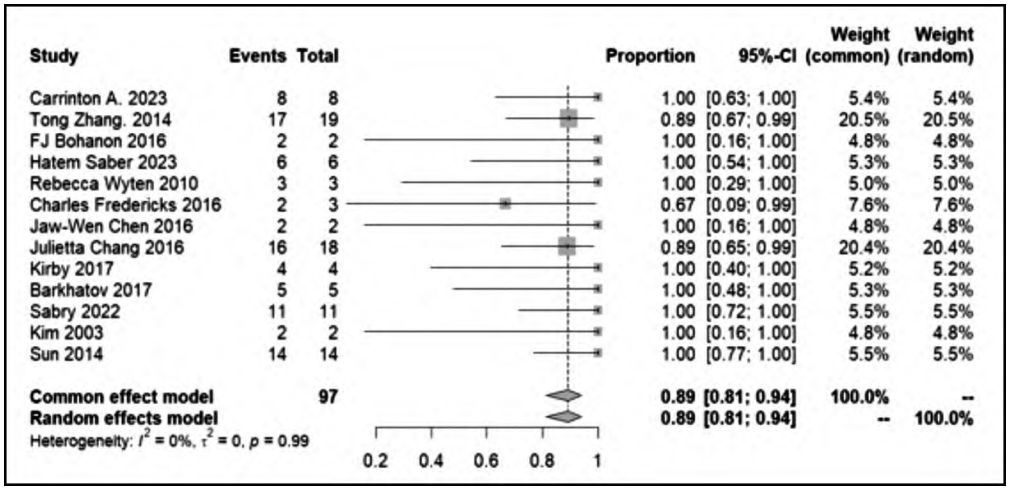

Fig. (2): Forest plot for the safety of duodenojejunostomy.

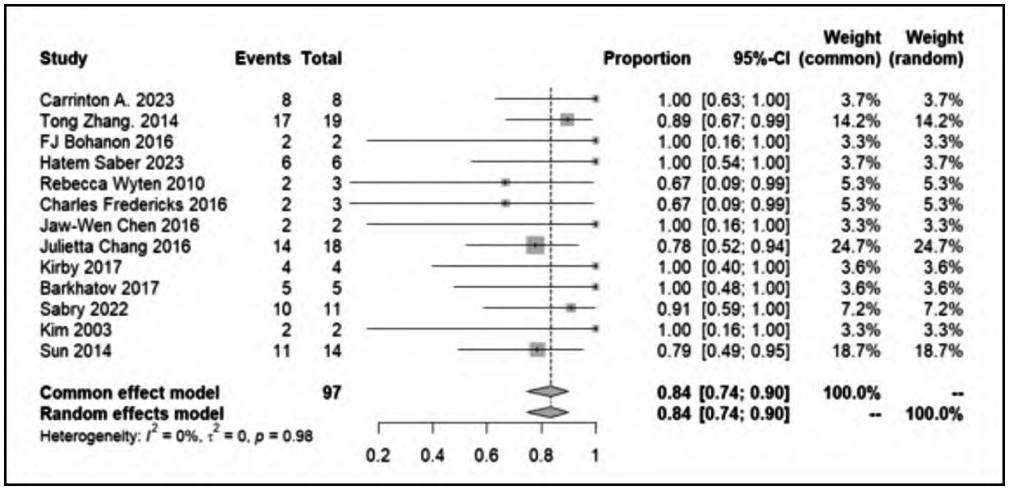

Fig. (3): Forest plot for the efficacy of duodenojejunostomy.

Table (5): Publication bias assessments.

	Bias	SE	Intercept	SE	*t*-test	*p*-value
Safety	0.1795	0.5193	1.92	0.6337	0.35	0.736
Efficacy	0.5739	0.4297	1.0813	0.4365	1.34	0.209

Egger's test was used. *: Significant *p*-value.

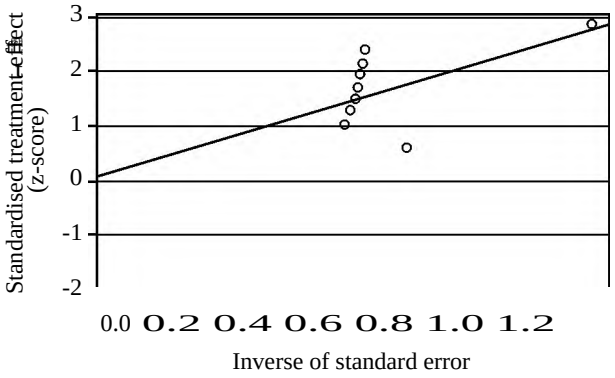

Fig. (4): Funel plot for safety.

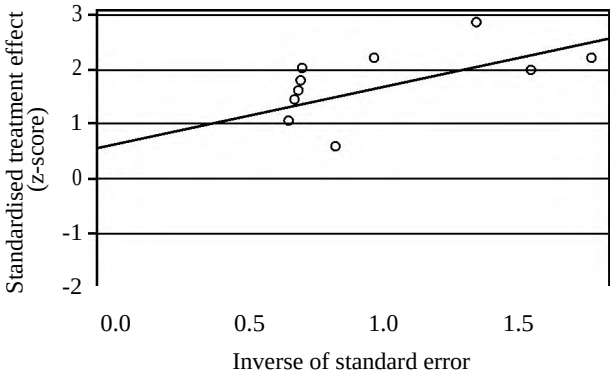

Fig. (5): Funnel plot for efficacy.

Discussion

The characteristics of the studies included in our meta-analysis highlight the diverse approaches and outcomes associated with duodenojejunostomy in the treatment of Superior Mesenteric Artery (SMA) syndrome. This variation underscores the complexity of diagnosing and managing this rare condition.

The synthesis of results:

The synthesis of results from multiple studies examining the safety and efficacy of duodenojejunostomy for the treatment of Superior Mesenteric Artery (SMA) syndrome provides comprehensive insights into the benefits and potential complications associated with this surgical intervention.

Synthesis of safety outcomes:

The safety profile of duodenojejunostomy, as evidenced by pooled outcomes from 13 studies, shows a high prevalence of safe outcomes with a value of 0.89 and a tight 95% confidence interval ranging from 0.81 to 0.94. This indicates a consistent safety record across multiple studies, signifying that the procedure is generally safe for patients with SMA syndrome.

Synthesis of efficacy outcomes:

The efficacy of duodenojejunostomy in treating SMA syndrome, with a pooled prevalence of 0.84 and a 95% confidence interval of 0.74 to 0.90, demonstrates a high level of effectiveness. This fixed effect model analysis with an I^2 of 0% indicates homogeneity among the study results, suggesting consistent efficacy across different studies and patient populations.

Individual study insights on efficacy:

- Rebecca Wyten's 2010 study found that one out of three patients had unresolved symptoms, indicating that while the majority benefit, a subset of patients may require further intervention or management.
- Charles Fredericks' 2016 study noted improvement in two of three patients, though the outcome for the third was unclear, possibly indicating variable responses to the procedure.

- Sabry's 2022 study showed that most patients experienced significant symptom relief, though occasional symptoms persisted in a minority, underscoring the need for tailored postoperative care.
- Sun's 2014 study and Chang's 2016 study both highlighted that a portion of patients continued to experience symptoms post-surgery, suggesting variability in long-term outcomes and the possible need for additional treatments or lifestyle adjustments.

These efficacy results reinforce the procedure's utility in effectively managing symptoms of SMA syndrome but also highlight the potential for persistent or recurring symptoms in some patients.

The forest plots for both safety and efficacy provide a visual representation of these findings, enabling a clearer understanding of the data distribution and the effect sizes observed across the studies. These plots are crucial for interpreting the variability and central tendencies of the reported outcomes.

The synthesized results from the studies suggest that duodenojejunostomy is both safe and effective for the majority of patients with SMA syndrome. However, the noted complications and the persistence of symptoms in some patients highlight the need for careful patient selection, meticulous surgical execution, and comprehensive postoperative care. Further research may focus on identifying predictors of success and factors associated with poorer outcomes to optimize the use of duodenojejunostomy in clinical practice.

The assessment of publication bias across studies analyzing the safety and efficacy of duodenojejunostomy for Superior Mesenteric Artery (SMA) syndrome was crucial to ensure that the synthesized results were not skewed by the selective publication of studies. The analysis involving funnel plots and Egger's test provided a statistical basis to judge the integrity of the research findings.

Assessment of publication bias:

Funnel plot analysis:

Funnel plots were used as graphical tools to detect bias in meta-analyses and systematic reviews. The symmetry of these plots for both safety and efficacy suggested that there was a low likelihood of publication bias within the included studies. Symmetrical funnel plots indicated that the studies were evenly distributed around the average effect size, regardless of the study size, implying that smaller studies did not systematically report higher or lower effect sizes.

Egger's test:

Egger's test provided a more quantitative approach to the assessment of publication bias by measuring the funnel plot asymmetry on a regression basis. The results from Egger's test for both safety and efficacy indicated no significant publication bias:

- *Safety:* The intercept of 1.92 with a standard error of 0.6337 and a *p*-value of 0.736 suggested no evidence of bias, as the *p*-value was well above the conventional threshold of 0.05.
- *Efficacy:* Similarly, an intercept of 1.0813 with a standard error of 0.4365 and a *p*-value of 0.209 also indicated a lack of significant publication bias.

These statistical outcomes reassured that the meta-analytic results were robust and not unduly influenced by the non-publication of smaller or unfavorable studies.

Implications of bias assessment:

The absence of significant publication bias enhanced the credibility of the meta-analysis, suggesting that the estimated effects of safety and efficacy were likely to be reliable reflections of the true effects. This robustness was critical for clinical decision-making and policy formulation, as it underpinned the confidence that healthcare providers and patients could have in the expected outcomes of duodenojejunostomy for treating SMA syndrome.

The funnel plots associated with this analysis, although not displayed here, served as essential visual checks of the spread and symmetry of the included studies around the effect size. These plots would typically show data points representing each study's effect estimate plotted against a measure of study size or precision. The symmetry observed in these plots complemented the numerical findings from Egger's test, providing a comprehensive view of the publication landscape.

The rigorous assessment of publication bias indicated that the findings related to the safety and efficacy of duodenojejunostomy for SMA syndrome were robust and free from significant bias. Healthcare practitioners and stakeholders could rely on these results, knowing that they reflected a balanced view of the available evidence. This reassurance supported the broader application of these findings in clinical guidelines and patient care strategies, ensuring that decisions were based on unbiased and accurate information.

Our review is consistent with previous studies, which demonstrate varying degrees of success with different surgical interventions for Superior Mesenteric Artery Syndrome (SMAS). These studies reflect a general effectiveness in alleviating symptoms associated with SMAS but also highlight some significant concerns regarding long-term outcomes and complications.

A retrospective study by Cienfuegos et al. *[13]* explored the long-term results of 13 patients under-

going laparoscopic latero-lateral duodenojejunostomy for SMAS, consisting predominantly of women (10 out of 13). The study found no need for surgical revision post-procedure, though one patient experienced a temporary delay in gastric emptying. Over a median follow-up of 94 months, 61.5% reported excellent outcomes. However, there were noted complications, including symptom relapse in one patient requiring further surgery and persistent gastric emptying issues in two others. This suggests that while duodenojejunostomy is generally effective, it may necessitate concurrent management of other gastric motility disorders to ensure optimal patient outcomes.

Meta-Analysis on Uncut Roux-en-Y vs. Standard Roux-en-Y Gastrojejunostomy: Sun et al. *[14]* conducted a meta-analysis to compare uncut Roux-en-Y (U-RY) and standard Roux-en-Y (RY) gastrojejunostomy after distal gastrectomy for gastric cancer. The analysis, incorporating both randomized controlled trials and observational studies, indicated significant advantages of U-RY, including reduced operative times and lower incidence of complications like reflux gastritis/esophagitis and delayed gastric emptying. Moreover, higher serum albumin levels in the U-RY group suggested better postoperative nutritional status. These findings endorse U-RY as a potentially better option due to its clinical advantages over standard RY in terms of reducing postoperative complications and enhancing recovery.

A study by Ayloo et al. *[15]* investigates the application of the da Vinci robotic system in performing Roux-en-Y duodenojejunostomy for SMA syndrome. This detailed report discusses a case where a 39-year-old patient underwent a robotic surgical procedure to alleviate symptoms of intestinal obstruction. The robotic approach allowed for precise mobilization of the colon and duodenum with hand-sewn anastomosis, resulting in minimal blood loss and an operative time of 120 minutes. The postoperative period was uneventful with a rapid resolution of symptoms, underscoring the feasibility and safety of robotic surgery as a minimally invasive alternative to open surgery for SMA syndrome. The study highlights the potential benefits of robotic surgery, including reduced recovery time and fewer complications.

Long-Term Outcomes of Roux-en-Y vs. Duodenojejunostomy: A comprehensive review by Chen et al. *[9]* details the outcomes of different surgical approaches for SMAS at a single institution over twelve years. The study included 14 patients with confirmed SMAS diagnoses who underwent surgical treatment after failing conservative management. Among the surgeries performed, four were duodenojejunostomies, one was a mini-laparotomy duodenojejunostomy bypass, and one was a Roux-en-Y duodenojejunal bypass with duodenal feeding tube insertion. The study reports that all patients initially showed symptom resolution, although there were recurrences in some cases. It emphasizes the importance of selecting an appropriate surgical approach based on individual patient characteristics and the potential advantages of minimally invasive or mini-laparotomy techniques in providing effective treatment with reduced operative times and faster recovery.

Comparative Analysis of Surgical Techniques for Gastric Cancer: Although not directly related to SMAS, the study by Major et al. *[16]* provides insights into the comparative outcomes of circular- and linear-stapled gastrojejunostomy in laparoscopic Roux-en-Y gastric bypass, a procedure analogous in technical aspects. This retrospective case-control study analyzed 457 patients, revealing that the choice of stapling technique significantly impacts operative time and postoperative complications, such as bleeding and wound infection. The study concludes that while both techniques are safe, the choice between circular and linear stapling may depend on specific clinical contexts and surgeon preference, highlighting the broader relevance of surgical technique selection in gastrointestinal surgeries.

These detailed insights from the studies underscore the importance of considering both short-term efficacy and long-term patient outcomes when selecting the optimal surgical intervention for SMAS. Each approach offers distinct advantages, which should be weighed in clinical decision-making based on individual patient conditions.

Research on surgical interventions, especially for conditions like Superior Mesenteric Artery Syndrome (SMAS), often presents varied and sometimes conflicting outcomes.

A study by Fujita et al. *[17]* examined the short-term outcomes of Roux-en-Y gastrojejunostomy using mechanical stapling in distal gastrectomy for gastric adenocarcinoma. The study highlighted increased incidents of delayed gastric emptying in the group where mechanical stapling was used for Roux-en-Y reconstruction compared to hand suturing. This finding suggests potential drawbacks in the mechanical approach, which might translate into considerations for SMAS procedures that require careful handling of gastrointestinal motility.

A retrospective chart review by Dekonenko et al. *[8]* evaluated the outcomes following different surgical approaches for SMAS, including duodenojejunostomy and the less commonly used Strong procedure. While most patients experienced symptom resolution, a notable proportion (25%) had symptom recurrence. The study presents a critical view on the effectiveness of conventional surgical approaches and suggests that even with successful initial outcomes, long-term effectiveness can be variable, indicating a need for ongoing evaluation and potential refinement of surgical techniques.

The research by Bouras et al. **[18]** on laparoscopic distal gastrectomy with Roux-en-Y reconstruction focused on gastric cancer but provides relevant insights into gastrointestinal surgical outcomes. The study reported complications such as anastomotic leakage and postoperative stasis in a small percentage of patients. These complications highlight potential long-term issues associated with Roux-en-Y reconstructions, underscoring the importance of meticulous surgical technique and patient selection to minimize adverse outcomes.

These studies collectively illustrate that while surgical interventions like duodenojejunostomy and Roux-en-Y gastrojejunostomy are often effective, they are not without risks and complications. The conflicting results or studies not supporting the unconditional efficacy of these procedures emphasize the necessity for individualized patient assessments and highlight the need for ongoing research to optimize surgical strategies and minimize risks.

Conclusion:

The results from the meta-analysis indicate that both duodenojejunostomy and Roux-en-Y gastrojejunostomy are effective surgical options for treating SMA syndrome. Duodenojejunostomy showed a high prevalence of safe outcomes (0.89) and efficacy (0.84), indicating it is generally a safe and effective procedure. Key studies highlighted the rapid postoperative recovery and sustained symptom relief provided by this surgery. However, complications such as anastomotic edema and prolonged ileus were noted in some cases, emphasizing the need for careful surgical technique and postoperative management.

Roux-en-Y gastrojejunostomy also demonstrated significant benefits, especially in elderly patients with severe symptoms. The procedure effectively alleviated symptoms such as vomiting, abdominal pain, and weight loss, contributing to improved nutritional status and overall quality of life. However, occasional minor postoperative issues like anastomotic stricture were reported.

The risk of bias assessment indicated a predominantly low risk of bias, enhancing the credibility of the surgical outcomes reported. The synthesis of results suggests that both surgical interventions provide substantial and durable benefits for patients with SMA syndrome. However, persistent or recurring symptoms in some patients highlight the need for meticulous patient selection, surgical execution, and comprehensive postoperative care.

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مقارنة توصيل الاثنى عشر بالصائم مع توصيل المعدة بالصائم لعلاج متلازمة الشريان المساريقى العلوى : دراسة منهجية

الخلفية: تُعتبر متلازمة الشريان المساريقى العلوى من الحالات النادرة والخطيرة التى تؤدى إلى انسداد الجزء الثالث من الاثنى عشر نتيجة للضغط الواقع عليه بين الشريان المساريقي العلوي والشريان الأبهر البطنى. تُسبب هذه الحالة مجموعة من الأعراض الحادة مثل آلام شديدة فى البطن، غثيان مستمر، قىء متكرر، وفقدان شديد فى الوزن، مما قد يؤدى إلى سوء تغذية حاد. فى الحالات التى تفشل فيها العلاجات التقليدية، يكون التدخل الجراحى ضروريًا.

الهدف: تهدف هذه الدراسة إلى مقارنة فعالية وأمان نوعين من الجراحات المستخدمة لعلاج متلازمة الشريان المساريقى العلوى. النوع الأول من الجراحة يشمل تحويل مسار الاثنى عشر إلى الصائم، فى حين يتضمن النوع الثانى إنشاء مفاغرة بين المعدة والصائم. تم التركيز فى هذه الدراسة على تقييم مدى فعالية كل من الجراحتين، ومعدلات الأمان المرتبطة بهما، بالإضافة إلى المضاعفات التى قد تحدث بعد الجراحة.

المنهجية: تم إجراء مراجعة منهجية وتحليل تلوي وفقًا لإرشادات PRISMA لمقارنة نتائج عمليتى تحويل الإثني عشر إلى الصائم وتحويل المعدة باستخدام تقنية Roux–en–Y في علاج مرضى متلازمة الشريان المساريقي العلوى. شملت المراجعة الدراسات المنشورة فى قواعد بيانات مثل PubMed وCochrane Library وEMBASE. تم اختيار الدراسات بناءً على معايير إدراج واستبعاد محددة مسبقًا، مع التركيز على المرضى الذين تتراوح أعمارهم بين ١٣ و٦٠ عامًا والذين تم تشخيصهم بشكل مؤكد بمتلازمة الشريان المساريقى العلوى. تم استخراج البيانات بواسطة مراجعين مستقلين، وتم تقييم جودة الدراسات المدرجة باستخدام معايير «كولى» المعدلة. تم إجراء التحليل الإحصائى باستخدام برنامج Rstudio، مع تجميع النتائج كميًا لتقييم فعالية وأمان التدخلات الجراحية.

النتائج: بعد فحص ١٠٨٣ مقالة، تم تضمين ٣٨ مقالة فى التحليل النوعى، و١٣ مقالة فى التحليل الكمى والتحليل التلوى. كان الناتج المشترك لمعيار السلامة لعملية تحويل الإثنى عشر إلى الصائم فى مرضى متلازمة الشريان المساريقى العلوى ٠.٨٩ (بفاصل ثقة ٩٥٪: ٠.٨١–٠.٩٤)، مع تباين طفيف (I^2 = ٠٪). تضمنت المضاعفات الانسداد الوعائى فى منطقة المفاغرة، وذمة المفاغرة، وفقدان الدم بشكل كبير، وانسداد الأمعاء المطول. وكان الناتج المشترك لمعيار الفعالية ٠.٨٤ (بفاصل ثقة ٩٥٪: ٠.٧٤–٠.٩٠)، مع تباين طفيف أيضًا (I^2 = ٠٪). أشارت بعض الدراسات إلى استمرار بعض الأعراض مثل الغثيان المستمر، والتقيؤ، وآلام فى المنطقة الشرسوفية. كان خطر التحيز عبر الدراسات منخفضًا إلى متوسط، ولم يتم الكشف عن تحيز نشر مهم (قيمة الاحتمال > ٠,٠٥).

الاستنتاج: تعتبر عملية تحويل الإثنى عشر إلى الصائم الخيار الجراحي المفضل لعلاج متلازمة الشريان المساريقى العلوى بسبب نتائجها الأفضل بعد الجراحة وانخفاض معدلات المضاعفات. ومع ذلك، تظل تقنية Roux-en-Y خيارًا صالحًا فى الحالات المختارة. توفر هذه الدراسة رؤى قيمة لتحسين القرارات الجراحية وتسلط الضوء على الحاجة إلى خطط علاج فردية تستند إلى العوامل الخاصة بكل مريض.