Obesity Surgery
https://doi.org/10.1007/s11695-022-06353-w

ORIGINAL CONTRIBUTIONS

Comparing Patient Selection and 30-day Outcomes Between Single Anastomosis Gastric Bypass and Roux-en-Y Gastric Bypass: a Retrospective Cohort Study of 47,384 Patients

Valentin Mocanu[1] · Kevin Verhoeff[1] · Hayley Forbes[1] · Daniel W. Birch[2] · Shahzeer Karmali[2] · Noah J. Switzer[1]

Received: 20 July 2022 / Revised: 20 October 2022 / Accepted: 25 October 2022

Abstract

Purpose Single anastomosis gastric bypass (SAGB) offers a novel bariatric procedure with increasing popularity. However, its adoption, patient selection, and short-term safety remain poorly characterized.

Materials and Methods The 2020 Metabolic and Bariatric Accreditation and Quality Improvement Program (MBSAQIP) was analyzed comparing SAGB to Roux-en-Y gastric bypass (RYGB). Bivariate analysis and multivariable logistic regression models compared difference between groups and factors associated with 30-day serious complications and mortality.

Results Overall, 47,384 patients were evaluated, with 1344 (2.8%) undergoing SAGB. SAGB patients had a higher BMI (45.2 ± 7.6 kg/m^2 vs 44.6 ± 7.9 kg/m^2, $p = 0.006$) and younger age (44.3 ± 12.1 years vs. 45.4 ± 11.5 years, $p = 0.0008$) than RYGB patients respectively. SAGB patients were less likely to have GERD (42.6% SAGB vs. 45.7% RYGB, $p = 0.02$), sleep apnea (37.8% SAGB vs. 41.1% RYGB, $p = 0.02$), and chronic steroid use (1.3% SAGB vs. 2.2% RYGB, $p = 0.04$). There were no significant difference in diabetes, hypertension, or dyslipidemia rates. Operative length for SAGB was significantly less than for RYGB (101 ± 53.7 min SAGB vs. 131.5 ± 63.3 min RYGB, $p < 0.0001$). SAGB was independently associated with decreased serious complications (4.7% vs. 8.4%, $p < 0.0001$) within 30 days compared to RYGB. Additionally, SAGB patients were less likely to experience reoperation (1.6% vs. 2.6%, $p = 0.03$), and readmission (2.2 vs. 5.8%, $p < 0.0001$) compared to RYGB respectively.

Conclusions Compared to RYGB, patients undergoing SAGB were younger with marginally higher BMI. After adjusting for comorbidities, SAGB was associated with decreased odds of serious complications. Ongoing prospective studies analyzing long-term outcomes following SAGB remain needed.

Keywords SAGB · Single anastomosis gastric bypass · Bariatric surgery · RYGB

Introduction

Bariatric surgery remains the only therapy with robust long-term efficacy for the treatment of obesity and associated metabolic dysfunction. [1–4] Presently, Roux-en-Y gastric bypass (RYGB) remains the gold standard for bariatric procedures, with substantial long-term outcome data supporting its use. [5, 6] While RYGB remains the gold standard, it has a steep learning curve and remains one of the most technically demanding laparoscopic procedures. [7, 8] The single anastomosis gastric bypass also known as one anastomosis gastric bypass or mini-gastric bypass is a relatively new technique being first described in 2001, which has gained increasing popularity over the two decades. [9–11] Overall, the SAGB has been proposed to be a technically feasible, well-tolerated, effective, and safe metabolic procedure.

Key Points

- SAGB is offered to patients with less GERD, sleep apnea, and steroid use.
- SAGB is performed less than RYGB.
- After adjusting for comorbidities SAGB is associated with a reduced odds of serious complications.

✉ Valentin Mocanu
vmocanu@ualberta.ca

1 Department of Surgery, University of Alberta, Edmonton, Alberta, Canada

2 Centre for Advancement of Surgical Education and Simulation (CASES), Royal Alexandra Hospital, Edmonton, Alberta, Canada

Published online: 02 November 2022

[11–15] However, to date, our current understanding of SAGB patient selection and 30-day short-term outcomes remain poorly characterized.

Proponents of SAGB suggest that it offers the metabolic benefits of RYGB but benefits from increased safety due to the creation of a tension free gastro-jejunal anastomosis while avoiding the creation of the roux limb. [9, 16–19] The International Federation for the Surgery of Obesity and Metabolic disorders (IFSO) stated in their 2021 position statement that SAGB outcomes are “promising in terms of shorter operative time, low perioperative complication rate, good weight loss and good comorbidity remission and appear equivalent to other bariatric procedures”. [11, 20] However, despite this promise, large studies characterizing patient selection, perioperative outcomes, and comparing SAGB to the gold standard RYGB are lacking, which may limit its adoption. [9, 20, 21]

We aimed to evaluate differences in patient selection and perioperative outcomes for patients undergoing SAGB and RYGB using the Metabolic and Bariatric Surgery Accreditation and Quality Improvement Program (MBSAQIP) data registry. We also aimed to evaluate the independent effects of SAGB on mortality and serious complications using multivariable logistic regression.

Material and Methods

Data Source

Data from the MBSAQIP database was evaluated using the 2020 operative year, encompassing the first year of clear data collection on SAGB. Prior to the 2020 year, only 341 SAGB were reported by MBSAQIP, due to unclear characterization and inclusion of these cases in the data registry. The MBSAQIP prospectively collects data for patients that are undergoing a variety of bariatric surgeries in over 800 centres across North America. [22] It contains information from nearly 1 million patients on key pre-operative, operative, and post-operative outcomes. Only centres accredited by MBSAQIP and whom undergo frequent review contribute data to ensure accuracy and reliability through the collection process. All data collected in the MBSAQIP database is collected anonymously and covers pre-defined standardized variables. [22]

Study Design, Patient Population, and Variable Definitions

This retrospective cohort study was conducted by identifying patients who underwent SAGB and RYGB. SAGB cases were identified if the initial procedure description was defined as “Single anastomosis gastric bypass” while RYGB cases were identified by CPT code (43,664). Patients undergoing alternative bariatric procedures including sleeve gastrectomy, intragastric balloon, standard duodenal switch, single anastomosis duodeno-ileal bypass with sleeve gastrectomy, and gastric bands were excluded. Additionally, patients whom were undergoing re-do, emergency, conversion, or non-elective bariatric surgery were excluded.

The primary outcome of this study was to assess patient selection and 30-day perioperative outcomes for patients undergoing SAGB compared to RYGB. Secondary outcomes were to evaluate differences in serious complications and 30-day mortality using multivariable logistic regression.

To assess selection of patients for each procedure, the following patient demographics were obtained and compared between cohorts: age, sex, race, and pre-operative body mass index (BMI). Cardiac, pulmonary, and metabolic comorbidities were evaluated to characterize patient selection for each procedure. These included hyperlipidemia, hypertension, previous myocardial infarction (MI), previous percutaneous coronary intervention (PCI), previous cardiac surgery, active smoking, sleep apnea, chronic obstructive pulmonary disease (COPD), history of venous thromboembolism (VTE), gastroesophageal reflux disease (GERD), diabetes mellitus (DM), venous stasis, renal insufficiency, dialysis dependency, therapeutic anticoagulation, and chronic steroid use. In addition to demographics, operative time of both techniques was compared.

The perioperative 30-day outcomes evaluated included rates of readmission, reoperation and reintervention. Readmission was defined as any acute care admission to hospital or care provided as an outpatient spanning over 2 days, while reoperation was any procedure requiring sedation or anesthesia within the operating room, and reintervention was defined as any other procedure using local anesthesia, sedation, or general anesthetic. Outcomes were collected and defined as per the MBSAQIP 2020 Participant Use Data File and MBSAQIP Operations Manual. [22] Other complications that were reported included rates of deep surgical site infections (SSI), wound disruption, urinary tract infections (UTI), pneumonia, sepsis, unplanned intubation, acute renal failure (described as any renal failure requiring dialysis), myocardial infarction (MI), and cerebral vascular accidents (CVA). In addition to these complications, we also evaluated rates of postoperatively bleeding, anastomotic leak, overall serious complications, and mortality. Our composite variable of serious complications was defined by any patient who had a cardiac arrest, myocardial infarction, acute renal failure, small bowel obstruction, a surgical site infection, wound disruption, pulmonary embolism, sepsis, leak, bleed, cerebrovascular event, *C. difficile* infection, or underwent reoperation, reintervention of readmission within 30-days.

Statistical Analysis

Continuous data was expressed as weighted mean ± standard deviation, whereas categorical data was expressed as absolute data with percentages. Differences in categorical data were evaluated using chi-squared tests while ANOVA tests were used to evaluate continuous data.

To determine independent predictors of 30-day serious complications or mortality, two independent multivariable logistic regression models were developed using a hypothesis driven purposeful selection methodology. Univariate analysis of variables with a p-value < 0.10 or from variables previously deemed clinically relevant to our primary outcome was used to generate a preliminary main effects model. Significant variables in the multivariable model were then identified (Wald test $p<0.05$) and linear assumption of continuous variables and multi-collinearity were checked using the variance inflation factor (VIF). Variables with a VIF greater than 10 were further explored using collinearity diagnostic tests and excluded from the final model if deemed collinear. The Brier score and the receiver-operating characteristic (ROC) curve were used to assess goodness of fit. All statistical analysis was performed using Stata 17 (STATACorp LP, College Station, TX).

Results

Patient Demographics

Of the 47,384 patients included in our analysis, a total of 1344 (2.8%) underwent SAGB. Patients undergoing SAGB were found to be statistically younger (44.3 ± 12.1 years vs. 45.4 ± 11.5, $p=0.0008$) and had a higher BMI (45.2 ± 7.6 kg/m^2 SAGB vs. 44.6 ± 7.9 RYGB, $p=0.006$). Notably, differences in BMI and age were small, and unlikely to be clinically significant. There were also statistical differences between the two groups with regards to both race and ASA class ($p<0.0001$) (Table 1). Other group differences appreciated included that SAGB patient were less likely to have a history of GERD (42.6% SAGB vs. 45.7% RYGB, $p=0.02$), sleep apnea (37.8% SAGB vs. 41.1% RYGB, $p=0.02$), venous stasis (0.2% SAGB vs. 0.8% RYGB, $p=0.02$), and chronic steroid use (1.3% SAGB vs. 2.2% RYGB, $p=0.04$). Other demographic factors were similar between cohorts (Table 1). Notably, the operative length was significantly shorter in the SAGB group (101 ± 53.7 min SAGB vs. 131.5 ± 63.3 min RYGB, $p<0.0001$).

Bivariate Analysis of Post-operative Outcomes

Patients that underwent SAGB had significantly reduced rates of 30-day reoperation (1.6% vs. 2.6%, $p=0.03$),

Table 1 Basic demographics of patients undergoing SAGB or RYGB

	RYGB **n=**46,040 n (%)	SAGB n=1,344 n (%)	**p-value**
Age (mean ± SD)	45.4 (11.5)	44.3 (12.1)	**0.0008**
BMI (Mmean ± SD)	44.6 (7.9)	45.2 (7.6)	**0.0057**
Female	38,598 (83.8)	1109 (82.5)	0.341
Race			**< 0.0001**
American Indian	311 (0.7)	4 (0.3)	
Asian	254 (0.6)	4 (0.3)	
African American	7768 (16.9)	204 (15.2)	
Native Hawaiian	120 (0.3)	3 (0.2)	
Race combination	25 (0.1)	0 (0)	
Other	160 (0.4)	0 (0)	
Unknown	4941 (10.7)	94 (7.0)	
Caucasian	32,469 (70.5)	1035 (77.0)	
ASA category			**< 0.0001**
ASA 1	69 (0.2)	3 (0.2)	
ASA 2	7663 (16.6)	198 (14.7)	
ASA 3	36,364 (79)	1107 (82.4)	
ASA 4	1,903 (4.1)	33 (2.5)	
ASA 5	3 (0.01)	1 (0.07)	
Smoker	2767 (6.0)	93 (6.9)	0.167
Diabetes			0.252
Non-diabetic and diet controlled	33,272 (72.3)	949 (70.6)	
Non-insulin dependent	8546 (18.6)	255 (19)	
Insulin dependent	4230 (9.2)	140 (10.4)	
HTN	21,868 (47.5)	637 (47.4)	0.946
GERD	21,034 (45.7)	572 (42.6)	**0.016**
COPD	668 (1.5)	25 (1.9)	0.218
DLD	11,996 (26.1)	357 (26.6)	0.674
Chronic steroids	1005 (2.2)	18 (1.3)	**0.036**
Renal insufficiency	256 (0.6)	8 (0.6)	0.849
Dialysis	93 (0.2)	5 (0.4)	0.176
Prior DVT	1018 (2.2)	22 (1.6)	0.157
Prior PE	766 (1.7)	17 (1.3)	0.258
History venous stasis	367 (0.8)	3 (0.2)	**0.018**
Therapeutic anticoagulation	1447 (3.1)	35 (2.6)	0.264
Sleep apnea	18,935 (41.1)	508 (37.8)	**0.015**
Prior MI	545 (1.2)	15 (1.1)	0.821
Prior cardiac surgery	417 (0.9)	18 (1.3)	0.1
Prior PCI	769 (1.7)	24 (1.8)	0.744
Surgical approach			**< 0.0001**
Laparoscopic	46,033 (99.97)	1340 (99.7)	
Open	10 (0.02)	0 (0)	
Operative length (mean ± SD)	131.5 (63.3)	101 (53.7)	**< 0.0001**

All bolded numbers represent p-values < 0.05

SAGB, single anastomosis gastric bypass; *RYGB*, Roux-en-Y gastric bypass; *SD*, standard deviation; *BMI*, body mass index; *ASA*, American Society of Anesthesiologists; *HTN*, hypertension; *GERD*, gastroesophageal reflux disease; *COPD*, chronic obstructive pulmonary disease; *DLD*, dyslipidemia; *DVT*, deep venous thrombosis; *PE*, pulmonary embolism; *MI*, myocardial infarction; *PCI*, percutaneous coronary intervention readmission (2.2% vs. 5.8%, $p < 0.0001$) and serious complications (4.7% vs. 8.4%, $p < 0.0001$) in comparison to RYGB patients (Table 2). Additional complications that were not found to be significant included reintervention (1.3% SAGB vs. 1.9% RYGB, $p = 0.08$), sepsis (0% SAGB vs. 0.3% RYGB, $p = 0.06$), or 30-day mortality (0.15% SAGV vs. 0.13% RYGB, $p = 0.9$).

Multivariable Logistic Regression for Predictors of 30-day Serious Complications and Mortality

After adjusting for comorbidities, the greatest protective factor for development of serious complications was undergoing SAGB (OR 0.61, $p < 0.0001$) followed by male gender (OR 0.79, $p < 0.0001$). Independent predictor of serious complications were prior renal insufficiency (OR 1.82, $p < 0.0001$), myocardial infarction (OR 1.6, $p < 0.0001$), and therapeutic anticoagulation (OR 1.44, $p < 0.0001$). Other risk factors found to be statically significant with regards to increased serious complications are older age, COPD, history of DVT, diabetes (type 1 or 2), smoker, and a history of a PE as demonstrated by Table 3. Evaluation of the serious complications model revealed an area under the curve of 0.609 and Brier score of 0.075.

Table 2 Post-operative complications of patients undergoing SAGB or RYGB

Complication	RYGB	SAGB	*p*-value
Reoperation	1207 (2.6%)	22 (1.6%)	**0.025**
Reintervention	888 (1.9%)	17 (1.3%)	0.08
Readmission	2679 (5.8%)	30 (2.2%)	**< 0.0001**
Leak	210 (0.46%)	3 (0.22%)	0.44
UTI	220 (0.48%)	2 (0.15%)	0.217
MI	14 (0.03%)	0 (0%)	0.523
Post op SSI	323 (0.7%)	4 (0.3%)	0.199
Sepsis	121 (0.3%)	0 (0%)	0.06
Deep SSI	78 (0.2%)	1 (0.1%)	0.692
Wound disruption	46 (0.1%)	0 (0%)	0.496
Pneumonia	212 (0.5%)	4 (0.3%)	0.383
Unplanned intubation	138 (0.3%)	1 (0.1%)	0.48
CVA	16 (0.03%)	0 (0%)	0.494
AKI	80 (0.2%)	2 (0.2%)	0.828
GI bleed	344 (0.8%)	5 (0.4%)	0.452
Dehydration	1894 (4.1%)	57 (4.2%)	0.816
Mortality	60 (0.13%)	2 (0.15%)	0.853
Serious complications	3858 (8.4%)	63 (4.7%)	**< 0.0001**

Not included number of emergency room visits. All bolded numbers represent *p*-values < 0.05

SAGB, single anastomosis gastric bypass; *RYGB*, Roux-en-Y gastric bypass; *SD*, standard deviation; *BMI*, body mass index; *UTI*, urinary tract infection; *MI*, myocardial infarction; *SSI*, superficial site infection; *CVA*, cerebrovascular accident; *AKI*, acute kidney injury; *GI*, gastrointestinal

Table 3 Multivariable logistic regression for 30-day serious complications

Risk factor	Odds ratio	95% Confidence interval	*p*-value
SAGB	0.61	0.47–0.79	**< 0.0001**
Older age (per 10 years)	0.96	0.93–1.00	**0.04**
GERD	1.27	1.18–1.36	**< 0.0001**
Higher BMI (per 5 kg/m^2)	0.93	0.91–0.95	**< 0.0001**
Male	0.79	0.71–0.87	**< 0.0001**
COPD	1.46	1.16–1.83	**0.001**
History of DVT	1.39	1.13–1.70	**0.002**
Diabetes (type 1)	0.86	0.78–0.94	**0.001**
Diabetes (type 2)	1.14	1.02–1.28	**0.026**
Operative length	1	1.00–1.00	**< 0.0001**
MI	1.6	1.26–2.04	**< 0.0001**
Renal insufficiency	1.82	1.30–2.54	**< 0.0001**
Smoker	1.18	1.04–1.35	**0.013**
History of PE	1.48	1.18–1.84	**0.001**
Therapeutic Anticoagulation	1.44	1.21–1.72	**< 0.0001**

All bolded numbers represent *p*-values < 0.05

BMI, body mass index; *OSA*, obstructive sleep apnea; *HTN*, hypertension; *DLD*, dyslipidemia; *MI*, myocardial infarction; *COPD*, chronic obstructive pulmonary disease

***Not included as no significance: race, obstructive sleep apnea, hypertension, dyslipidemia, dialysis

The most significant independent risk factors associated with 30-day mortality were post-operative leak (OR 22.92, $p < 0.0001$), post-operative gastrointestinal bleed (OR7.05, $p < 0.0001$), renal insufficiency (OR 6.98, $p < 0.0001$), older age (OR 2.38, $p < 0.0001$), and elevated BMI (OR 1.44, $p < 0.0001$). Other risk factors that were found to be statically significant were GERD, male gender, operative length, and myocardial infarction as demonstrated in Table 4. SAGB was not found to have any difference in terms of 30-day mortality (OR 1.54, $p = 0.551$). Evaluation of the 30-day mortality model revealed an area under the curve of 0.881 and Brier score of 0.0012.

Discussion

This study provides substantial evidence for patient selection and 30-day outcomes following SAGB compared to RYGB. Patients undergoing SAGB were younger with less GERD, sleep apnea, and chronic steroid use. However, there were no differences between rates of diabetes, hypertension, or dyslipidemia between procedures. Importantly, we found that fewer 30-day reoperations, readmissions, and serious complications occurred after SAGB and after adjusting for

Table 4 Multivariable logistic regression for 30-day mortality

Risk factor	Odds ratio	95% Confidence interval	*p*-value
SAGB	1.54	0.37–6.46	0.551
Older age (per 10 years)	2.38	1.77–3.20	**< 0.0001**
GERD	1.86	1.06–3.29	**0.032**
Higher BMI (per 5 kg/m^2)	1.44	1.24–1.68	**< 0.0001**
Male	2.17	1.18–3.98	**0.012**
OSA	0.57	0.32–1.00	0.051
Operative length	1	1.00–1.01	0.05
MI	2.75	1.04–7.24	**0.041**
Renal insufficiency	6.98	2.77–17.60	**< 0.0001**
Post op leak	22.92	10.40–50.47	**< 0.0001**
Post op GI bleed	7.05	2.91–17.09	**< 0.0001**
ROC = 0.88			

All bolded numbers represent *p*-values < 0.05

BMI, body mass index; *OSA*, obstructive sleep apnea; *HTN*, hypertension; *DLD*, dyslipidemia; *MI*, myocardial infarction; *COPD,* chronic obstructive pulmonary disease

***Not included as not significant HTN, DLD, COPD, history of DVT, diabetes, smoker, history of PE, use of anticoagulation

comorbidities, SAGB was found to be independently associated with a reduced odds of serious complications but no differences in mortality when compared to RYGB.

Our results provide strength to previous studies that suggest promising short-term perioperative outcomes following SAGB. [6] For example, prior meta-analysis has demonstrated that SAGB has relatively low complication rates and comparable rates of anastomotic leak and postoperatively bleeding to other procedures. [23] Further to these studies, our multivariable analysis controls for comorbidities and demonstrates superior perioperative outcomes following SAGB compared to RYGB. Although SAGB was not well identified in the MBSAQIP database prior to 2020 leading to studies with small sample sizes, previous analysis comparing SAGB to RYGB has indeed provided preliminary evidence suggesting improved short-term safety with SAGB. [24] Notably, recent work by Jung et al. and Docimo et al. using the MBSAQIP database suggested favourable safety profiles when comparing SAGB to sleeve gastrectomy (SG) and RYGB. [24, 25] We argue that these previous studies, however, compared SAGB to a non-anastomotic and non-bypass procedure (sleeve gastrectomy), had smaller sample sizes limiting their capacity to conduct multivariable modelling, and also used a relatively nebulous extraction of SAGB cases due to different procedural coding within the MBSAQIP prior to 2020.

Taken together, these findings build on previous literature which suggest that SAGB has reduced rates of serious complications, but also 30-day readmission and reoperation, which prior studies have not yet demonstrated. This may reflect ongoing optimization of the SAGB procedure with all procedures being completed in 2019–2020 compared to other studies reporting historical outcomes that may have been negatively impacted by SAGB learning curves. In our study, SAGB also demonstrated shorter operative times compared to RYGB, potentially supporting a trend towards increasing technical proficiency and decreasing learning curve effects. Despite the potential benefit of this study being less impacted by learning curve effect, ongoing optimization may still be possible with even better outcomes being a possibility in the future.

Alternatively, the discrepancy in our results compared to previous studies may represent characterization of complications such as medically managed malnutrition, marginal ulceration, biliary reflux, or dumping syndrome [23]; these outcomes are not captured by MBSAQIP, but have been reported to occur more frequently following SAGB. [25–27] In one study by Lee et al., nearly 40% of revisional procedures following SAGB have been reported to occur due to malnutrition, which has been shown to occur with increasing biliopancreatic limb length. [14, 28] Similarly, because of the anatomical considerations with OAGB, dumping syndrome, and bile reflux with potential risk of malignancy also remain concerns that must be monitored with long-term data. [29] Regardless, considering the relative perioperative safety demonstrated by previous studies and the substantial increase in number of patients evaluated in our study, current evidence suggests that SAGB offers an equal or potentially safer procedure than RYGB early after operative intervention. At the same time, this study highlights the need for longitudinal evaluation of SAGB outcomes, especially with regards to malnutrition, dumping syndrome, and bile reflux with associated malignancy risk.

Although helpful to guide patient selection and inform evaluation of short-term perioperative complications, it should be highlighted that our study does not reflect SAGB outcomes post 30 days. A number of studies demonstrate that SAGB may offer improved mid-term metabolic and anthropometric outcomes compared to RYGB, either as a primary or revisional procedure, yet outcomes beyond 5 years remain sparse. [15, 25, 30] The YOMEGA trial [31] offers the most substantive results for mid-term outcomes with 2-year follow-up demonstrating twice as many overall serious adverse events occurred within the SAGB group in comparison to the RYGB. Notably, 21% of those were related to long-term nutritional complications and ongoing evaluation of long-term outcomes for SAGB is needed. Overall, in the context of available data, IFSO statements support that outcomes of SAGB are overall promising in terms of reduced operative time and improved perioperative complication rates and comorbidities remission.

However, recent IFSO statements also caution that more data is needed to ensure the long-term metabolic, nutritional, and health outcomes of this procedure, a perspective our work is unable to address. The authors are in agreement with these IFSO caveats in light of results from recently conducted elegant experiments comparing long-term consequences of SAGB versus RYGB. Using rat models, Siebert et al. demonstrated that SAGB was associated with higher rates of bile acid mediated esophagitis, gastritis, and foveolar hyperplasia at 30 weeks. [32] Importantly, these changes were also observed even after minimizing biliopancreatic limb length to reduce bile reflux. It is clear, then, that further long-term human studies are required to better explore the long-term outcomes of SAGB, particularly with respect to bile acid reflux, esophageal metaplasia, and malnutrition. In summary, ongoing work evaluating long-term outcomes following SAGB, specifically with regards to nutritional and reflux outcomes will be paramount to evaluating the utility of this procedure.

There are a number of limitations to this study. The primary limitation being the nature of the retrospective study design and inherent limitations of the MBSAQIP data registry. The MBSAQIP data only incorporates data from the 885 centres belonging, and therefore outcomes and patient selection could dramatically vary between centres. Additionally, the MBSAQIP database also does not collect surgeon or center specific data, limiting our ability to evaluate the impact of learning curves on these outcomes or to generalize this information outside of centres that are presently performing SAGB, and if it is reproducible by surgeons with low case volumes. There is also significant heterogeneity in how SAGB is constructed with respect to limb length and pouch size, nuanced technical factors that are also not captured by the data registry. This data set was also collected during the COVID-19 pandemic, which may have impacted patient selection or outcomes. Additionally, there may be additional confounders that we did not adjust for, which may have an effect on our outcomes of interest. Lastly, as discussed, the MBSAQIP does not capture variables past 30 days, limiting our evaluation of long-term benefits from SAGB and limiting our ability to make comparisons of long-term metabolic outcomes.

Despite the aforementioned limitations, we present the largest study to date comparatively evaluating patient selection and perioperative outcomes for patients undergoing elective SABG. We show that SAGB is associated with favourable short-term 30-day outcomes when compared to RYGB. However, ongoing and additional prospective studies evaluating long-term outcomes, with focus on malabsorptive, reflux, and metabolic outcomes are needed to better inform these outcome measurements before broader uptake of SAGB is undertaken. Surgeons completing SAGB should be encouraged to report mid and long-term outcomes as they become available.

Conclusion

Use of SAGB remains relatively uncommon and comprises less than 3% of all conducted gastric bypasses within MBSAQIP centers. Patients who undergo SAGB appear to be younger with less GERD, and sleep apnea have similar rates of diabetes, hypertension, and dyslipidemia. After adjusting for comorbidities, SAGB has a reduced odds of serious complications than RYGB but no difference in 30-day mortality. Future high-quality prospective studies evaluating the risks and benefits of the SAGB and its long-term outcomes are needed before broader uptake.

Declarations

Ethical Approval All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

Conflict of Interest The authors declare no conflict of interests.

References

1. Driscoll S, Gregory DM, Fardy JM, et al. Long-term health-related quality of life in bariatric surgery patients: a systematic review and meta-analysis. Obesity. 2016;24(1):60–70.
2. Courcoulas AP, Yanovski SZ, Bonds D, et al. Long-term outcomes of bariatric surgery: a National Institutes of Health symposium. JAMA Surg. 2014;149(12):1323–9.
3. Courcoulas AP, Yanovski SZ, Bonds D, et al. Long-term outcomes of bariatric surgery: a National Institutes of Health symposium. JAMA Surg. 2014;149(12):1323–9.
4. Mingrone G, Panunzi S, de Gaetano A, et al. Bariatric surgery versus conventional medical therapy for type 2 diabetes. N Engl J Med. 2012;366(17):1577–85.

5. Nguyen NT, Varela JE. Bariatric surgery for obesity and metabolic disorders: state of the art. Nat Rev Gastroenterol Hepatol. 2017;14(3):160–9.
6. Soong TC, Lee MH, Lee WJ, et al. Long-term efficacy of bariatric surgery for the treatment of super-obesity: comparison of SG, RYGB, and OAGB. Obes Surg. 2021;31(8):3391–9.
7. El-Kadre L, Tinoco AC, Tinoco RC, et al. Overcoming the learning curve of laparoscopic Roux-en-Y gastric bypass: a 12-year experience. Surg Obes Relat Dis. 2013;9(6):867–72.
8. Shikora SA, Kim JJ, Tarnoff ME, et al. Laparoscopic Roux-en-Y gastric bypass: results and learning curve of a high-volume academic program. Arch Surg. 2005;140(4):362–7.
9. Lee WJ, Lin YH. Single-anastomosis gastric bypass (SAGB): appraisal of clinical evidence. Obes Surg. 2014;24(10):1749–56.
10. Almalki OM, Lee WJ, Chong K, et al. Laparoscopic gastric bypass for the treatment of type 2 diabetes: a comparison of Roux-en-Y versus single anastomosis gastric bypass. Surg Obes Relat Dis. 2018;14(4):509–15.
11. Aleman R, Menzo E lo, Szomstein S, et al. Efficiency and risks of one-anastomosis gastric bypass. Ann Transl Med. 2020;8(Suppl 1). https://doi.org/10.21037/atm.2020.02.03.
12. Bruzzi M, Rau C, Voron T, et al. Single anastomosis or mini-gastric bypass: long-term results and quality of life after a 5-year follow-up. Surg Obes Relat Dis. 2015;11(2):321–6.
13. Magouliotis DE, Tasiopoulou VS, Tzovaras G. One anastomosis gastric bypass versus Roux-en-Y gastric bypass for morbid obesity: an updated meta-analysis. Obes Surg. 2019;29(9):2721–30.
14. Carbajo MA, Luque-de-León E, Jiménez JM, et al. Laparoscopic one-anastomosis gastric bypass: technique, results, and long-term follow-up in 1200 patients. Obes Surg. 2017;27(5):1153–67.
15. Bhandari M, Nautiyal HK, Kosta S, et al. Comparison of one-anastomosis gastric bypass and Roux-en-Y gastric bypass for treatment of obesity: a 5-year study. Surg Obes Relat Dis. 2019;15(12):2038–44.
16. Soong TC, Lee MH, Lee WJ, et al. One anastomosis gastric bypass for the treatment of type 2 diabetes: long-term results and recurrence. Obes Surg. 2021;31(3):935–41.
17. Khrucharoen U, Juo YY, Chen Y, et al. Indications, operative techniques, and outcomes for revisional operation following mini-gastric bypass-one anastomosis gastric bypass: a systematic review. Obes Surg. 2020;30(4):1564–73.
18. Balsiger BM, Ernst D, Giachino D, et al. Prospective evaluation and 7-year follow-up of Swedish adjustable gastric banding in adults with extreme obesity. J Gastrointest Surg. 2007;11(11):1470–6; discussion 1446–7. https://doi.org/10.1007/s11605-007-0267-z.
19. Arble DM, Evers SS, Bozadjieva N, et al. Metabolic comparison of one-anastomosis gastric bypass, single-anastomosis duodenal-switch, Roux-en-Y gastric bypass, and vertical sleeve gastrectomy in rat. Surg Obes Relat Dis. 2018;14(12):1857–67.
20. de Luca M, Piatto G, Merola G, et al. IFSO update position statement on one anastomosis gastric bypass (OAGB). Obes Surg. 2021;31(7):3251–78. https://doi.org/10.1007/s11695-021-05413-x.
21. Lee WJ, Lin YH. Single-anastomosis gastric bypass (SAGB): appraisal of clinical evidence. Obes Surg. 2014;24(10):1749–56. https://doi.org/10.1007/s11695-014-1369-9.
22. MBSAQIP. User guide for the 2019 participant use data file (PUF). https://www.facs.org/quality-programs/accreditation-and-verification/metabolic-and-bariatric-surgery-accreditation-and-quality-improvement-program/participant-use-data-file-puf/. Published October 2020. Accessed May 26, 2022. https://www.facs.org/quality-programs/accreditation-and-verification/metabolic-and-bariatric-surgery-accreditation-and-quality-improvement-program/participant-use-data-file-puf/
23. Magouliotis DE, Tasiopoulou VS, Tzovaras G. One anastomosis gastric bypass versus Roux-en-Y gastric bypass for morbid obesity: an updated meta-analysis. Obes Surg. 2019;29(9):2721–30. https://doi.org/10.1007/s11695-019-04005-0.
24. Jung JJ, Park AK, Witkowski ER, et al. Comparison of short-term safety of one anastomosis gastric bypass to Roux-en-Y gastric bypass and sleeve gastrectomy in the United States: 341 cases from MBSAQIP-accredited Centers. Surg Obes Relat Dis. 2022;18(3):326–34. https://doi.org/10.1016/j.soard.2021.11.009.
25. Docimo S, Yang J, Zhang X, et al. One anastomosis gastric bypass versus Roux-en-Y gastric bypass: a 30-day follow-up review. Surg Endosc. 2022;36:498–503. https://doi.org/10.1007/s00464-021-08309-0.
26. Lee WJ, Almalki OM, Ser KH, et al. Randomized controlled trial of one anastomosis gastric bypass versus Roux-en-Y gastric bypass for obesity: comparison of the YOMEGA and Taiwan studies. Obes Surg. 2019;29(9):3047–53. https://doi.org/10.1007/s11695-019-04065-2.
27. Rheinwalt KP, Plamper A, Rückbeil MV, et al. One anastomosis gastric bypass-mini-gastric bypass (OAGB-MGB) versus Roux-en-Y gastric bypass (RYGB)-a mid-term cohort study with 612 patients. Obes Surg. 2020;30(4):1230–40. https://doi.org/10.1007/s11695-019-04250-3.
28. Lee WJ, Wang W, Lee YC, et al. Laparoscopic mini-gastric bypass: experience with tailored bypass limb according to body weight. Obes Surg. 2008;18:294–9. https://doi.org/10.1007/s11695-007-9367-9.
29. Solouki A, Kermansaravi M, DavarpanahJazi AH, et al. One-anastomosis gastric bypass as an alternative procedure of choice in morbidly obese patients. J Res Med Sci. 2018;24(23):84. https://doi.org/10.4103/jrms.JRMS_386_18.
30. Poublon N, Chidi I, Bethlehem M, et al. One anastomosis gastric bypass vs. Roux-en-Y gastric bypass, remedy for insufficient weight loss and weight regain after failed restrictive bariatric surgery. Obes Surg. 2020;30(9):3287–94. https://doi.org/10.1007/s11695-020-04536-x.
31. Robert M, Espalieu P, Pelascini E, et al. Efficacy and safety of one anastomosis gastric bypass versus Roux-en-Y gastric bypass for obesity (YOMEGA): a multicentre, randomised, open-label, non-inferiority trial. The Lancet. 2019;393(10178):1299–309. https://doi.org/10.1016/S0140-6736(19)30475-1.
32. Siebert M, Ribeiro-Parenti L, Nguyen ND, et al. Long-term consequences of one anastomosis gastric bypass on esogastric mucosa in a preclinical rat model. Sci Rep. 2020;10(1):7393. https://doi.org/10.1038/s41598-020-64425-2.