

Roux-en-Y gastric bypass and one-anastomosis gastric bypass are associated with greater HbA1c reduction and diabetic remission compared with sleeve gastrectomy: Two-year follow-up of 121 patients

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Abstract

Objective: To compare the effects of Roux-en-Y gastric bypass (RYGB), one-anastomosis gastric bypass (OAGB), and laparoscopic sleeve gastrectomy (LSG) on glycaemic control and weight loss in patients with type 2 diabetes mellitus (T2DM) and obesity over two years.

Methods: Retrospective analysis of a prospectively maintained database of consecutive adults with T2DM and BMI ≥ 35 kg/m² who underwent RYGB, OAGB, or LSG between February 2015 and February 2020. Primary outcome: change in HbA1c from baseline to two years. Secondary outcomes: T2DM remission (HbA1c <48 mmol/mol), percentage total weight loss (%TWL), and percentage excess weight loss (%EWL). Analysis used one-way ANOVA with Tukey post-hoc tests and chi-square with Bonferroni correction.

Results: Among 121 patients (27 OAGB, 68 RYGB, 26 LSG), baseline characteristics were similar across groups. Mean HbA1c reduction was greatest after RYGB (20.0 mmol/mol), followed by OAGB (15.4 mmol/mol) and LSG (2.5 mmol/mol) ($p < 0.001$). Both bypass procedures were superior to LSG; RYGB vs OAGB did not reach significance ($p = 0.361$). Overall, the diabetic remission rate was 71.9%. RYGB and OAGB were associated with significantly higher remission rates than LSG ($p < 0.001$). %TWL was greater after RYGB and OAGB versus LSG ($p < 0.001$). OAGB produced a greater %EWL than RYGB and LSG. Sex was not associated with glycaemic outcomes ($p = 0.95$).

Conclusions: RYGB and OAGB are associated with superior glycaemic control and weight loss compared with LSG at two years. The difference between bypass procedures was not statistically significant. These findings support the use of gastric bypass over sleeve gastrectomy for patients with T2DM and obesity.

Keywords: Bariatric surgery, Diabetes mellitus type 2, Glycated haemoglobin, Gastric bypass, Sleeve gastrectomy

Plain English Summary

This study looked at three types of weight-loss surgery in 121 people with type 2 diabetes and

obesity. The surgeries were Roux-en-Y gastric bypass (RYGB), one-anastomosis gastric bypass (OAGB), and sleeve gastrectomy (LSG).

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Over two years, we measured blood sugar levels (HbA1c), diabetes remission (blood sugar returning to the normal range), and weight loss. Both bypass procedures (RYGB and OAGB) lowered blood sugar more effectively than sleeve gastrectomy. About 72 out of every 100 patients achieved remission of diabetes. Weight loss was also better with bypass surgeries, though OAGB led to slightly more excess weight loss than RYGB. Men and women had similar improvements in diabetes control. The differences between the two bypass procedures were not large enough to say one is clearly better than the other. These results help doctors and patients choose the right surgery when diabetes control is a major goal.

Introduction

Metabolic (bariatric) surgery is currently the most effective intervention for achieving durable weight loss and improving glycaemic control in patients with obesity and type 2 diabetes mellitus (T2DM), even as novel glucagon-like peptide-1 (GLP-1) and glucose-dependent insulinotropic polypeptide (GIP) agonists offer promising medical alternatives (1, 2, 3). Among surgical options, Roux-en-Y gastric bypass (RYGB), one-anastomosis gastric bypass (OAGB), and laparoscopic sleeve gastrectomy (LSG) are the most performed procedures worldwide (4). However, the comparative effectiveness of these three operations for HbA1c reduction and diabetic remission remains debated, with conflicting evidence from randomised trials and observational studies (5, 6, 7, 8).

The impact of metabolic surgery on glycaemic control is multifactorial, influenced by both procedural characteristics (pouch size, limb lengths, bypassed small bowel) and patient factors such as age, body mass index (BMI), duration of diabetes, preoperative HbA1c, C-peptide levels, medication burden, insulin use, and pancreatic islet cell function (9, 10, 11, 12). Understanding which procedure offers the greatest metabolic benefit is essential for personalised surgical decision-making.

An additional layer of complexity involves sex differences in body fat distribution. Visceral adipose tissue, which is hormonally active and correlates strongly with metabolic derangements, is more abundant in men than in premenopausal women (13). Metabolic surgery reduces visceral fat substantially (14), and some studies have suggested that baseline visceral-to-abdominal fat ratio may predict diabetes remission after bariatric surgery (15, 16). However, it remains unclear whether sex, as a proxy for fat distribution, independently influences glycaemic outcomes following different procedures.

This study aimed to compare HbA1c reduction, diabetic remission, and weight loss after RYGB, OAGB, and LSG over a two-year follow-up period. A secondary objective was to explore whether sex was associated with differential glycaemic outcomes, acknowledging that direct measurement of fat distribution was not available.

Materials and Methods

Study design and reporting

We conducted a retrospective analysis of a prospectively maintained database of consecutive patients undergoing primary metabolic/bariatric surgery at Homerton University Hospital, London, between February 2015 and February 2020. The study followed the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) guidelines (17).

Inclusion and exclusion criteria

Adult patients (aged ≥ 18 years) with a diagnosis of T2DM and a preoperative BMI of 35 kg/m^2 or higher who underwent RYGB, OAGB, or LSG were included. T2DM was diagnosed based on HbA1c $>48 \text{ mmol/mol}$ (6.5%) before or at the time of referral for bariatric surgery. Exclusion criteria were revisional bariatric surgery, non-diabetic status, gastric band procedures, and missing baseline or two-year HbA1c data.

Surgical techniques

All procedures were performed by a team of dedicated bariatric surgeons using standardised techniques. RYGB involved a 30 mL gastric pouch, an 80 cm biliopancreatic limb, and a 120 cm Roux limb. OAGB consisted of a 12–15 cm long gastric pouch with a gastro-jejunostomy using a 45 mm linear stapler cartridge and a biliopancreatic limb length of 150–180 cm. LSG was performed by dividing the gastro-colic and gastro-splenic ligaments, starting stapling 5 cm from the pylorus and continuing to the gastro-oesophageal junction over a 34-Fr orogastric bougie.

Data collection

Data were extracted from the hospital's electronic intranet system and the bariatric team's prospectively maintained database. Access was restricted to the research team, and all data were anonymised. Collected variables included age, sex, weight, BMI, preoperative HbA1c, procedure type, and two-year follow-up measurements of HbA1c, weight, and medication use (where documented). HbA1c was measured at baseline and at regular intervals postoperatively (three-monthly in year one, six-monthly in year two).

Outcomes

The primary outcome was the absolute change in HbA1c (mmol/mol) from baseline to two years post-surgery. Secondary outcomes were: (1) T2DM remission at two years, defined as HbA1c <48 mmol/mol (per Diabetes UK criteria) (18); (2) percentage total weight loss (%TWL); and (3) percentage excess weight loss (%EWL). Excess weight was calculated using the ideal body weight corresponding to a BMI of 25 kg/m². We note that complete remission according to standard definitions also requires discontinuation of glucose-lowering medications; however, reliable medication data were not consistently available in the database, and this limitation is addressed in the discussion.

Statistical analysis

Continuous variables were summarised as means with standard deviations (where available) or ranges, and categorical variables as counts and percentages. Differences among the three procedure groups were assessed using one-way analysis of variance (ANOVA) for continuous variables, followed by Tukey's Honestly Significant Difference (HSD) post-hoc test for pairwise comparisons. Categorical outcomes were compared using the chi-square test with Bonferroni correction for multiple pairwise comparisons. Given the observational

nature of the study, we did not perform formal propensity matching; instead, we present baseline comparability and note that unmeasured confounding may remain. All tests were two-tailed, and a p-value <0.05 was considered statistically significant. Statistical analyses were performed using SPSS version 19 (IBM Corp., Armonk, NY, USA).

Missing data and attrition

Of the original cohort, five patients (4.1%) were lost to weight-loss follow-up, but HbA1c data at two years were complete for all 121 patients included in the analysis. No patients were excluded from the primary outcome analysis due to missing HbA1c. Attrition did not differ significantly by procedure group (data not shown), and no imputation methods were applied.

Results

Baseline patient characteristics

A total of 121 patients met the inclusion criteria, comprising 27 OAGB, 68 RYGB, and 26 LSG procedures. Baseline characteristics are shown in Table 1. The three groups were similar with respect to age, preoperative weight, BMI, baseline HbA1c, and sex distribution (all p >0.05), indicating adequate comparability for the measured variables.

Table 1: Baseline characteristics of the study cohort by procedure group

Variable	OAGB (n=27)	RYGB (n=68)	LSG (n=26)	p-value*
Age (years), mean (range)	53 (32–68)	49 (27–71)	51 (30–69)	0.098
Preoperative weight (kg), mean (range)	132.9 (98–178)	139.9 (95–210)	137.1 (100–185)	0.525
Preoperative BMI (kg/m ²), mean (range)	47.0 (35–62)	48.5 (35–72)	49.2 (35–68)	0.606
Preoperative HbA1c (mmol/mol), mean (range)	59 (49–110)	61 (48–120)	61 (48–115)	0.804
Male sex, n (%)	10 (37.0)	26 (38.2)	9 (34.6)	0.95

*One-way ANOVA for continuous variables; chi-square test for categorical variables. Data presented as mean with range because standard deviations were not available from the source database

Glycaemic outcomes

The mean reduction in HbA1c from baseline to two years differed significantly among the three groups (one-way ANOVA, p < 0.001). As shown

in Figure 1, RYGB was associated with the largest mean reduction (approximately 20.0 mmol/mol), followed by OAGB (15.4 mmol/mol) and LSG (2.5 mmol/mol).

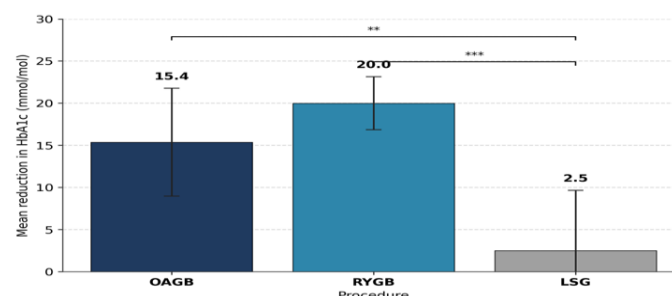


Figure 1: Mean reduction in HbA1c (mmol/mol) at two years by procedure

*Bars represent mean reduction with 95% confidence interval error bars. RYGB produced the greatest mean reduction (≈20.0 mmol/mol), followed by OAGB (≈15.4 mmol/mol) and LSG (≈2.5 mmol/mol) Significance: ** p=0.006 (OAGB vs LSG); *** p<0.001 (RYGB vs LSG); RYGB vs OAGB non-significant (p=0.361).*

Tukey post-hoc pairwise comparisons (Table 2) revealed that both RYGB ($p < 0.001$) and OAGB ($p = 0.006$) were superior to LSG. The difference

between RYGB and OAGB did not reach statistical significance ($p = 0.361$).

Table 2: Pairwise comparisons of mean HbA1c reduction (Tukey HSD post-hoc)

Procedure (I)	Comparator (J)	Adjusted p-value
OAGB	RYGB	0.361
OAGB	LSG	0.006
RYGB	OAGB	0.361
RYGB	LSG	<0.001
LSG	OAGB	0.006
LSG	RYGB	<0.001

Bold values indicate statistical significance at $p < 0.05$

The overall T2DM remission rate (HbA1c < 48 mmol/mol) at two years was 71.9% (87 of 121 patients). The proportion of patients achieving remission differed significantly by procedure group (chi-square $p < 0.001$). Bonferroni-corrected pairwise comparisons showed that LSG was associated with significantly fewer remissions compared with both RYGB and OAGB ($p < 0.05$ for each comparison). There was no significant difference in remission rates between RYGB and OAGB ($p = 1.00$). Of note, medication discontinuation data were not consistently available; therefore, these remission rates should be interpreted as glycaemic remission based on HbA1c alone, and not as complete drug-free remission.

We also examined whether age or sex influenced HbA1c reduction. Mean HbA1c reduction did not differ significantly by age group ($p = 0.568$, one-

way ANOVA) or sex ($p = 0.244$). Similarly, remission rates were similar between men and women ($p = 0.882$). These findings suggest that, within this cohort, sex was not associated with differential glycaemic benefit from metabolic surgery. However, we caution that this analysis does not directly test the role of visceral fat distribution, which was not measured.

Weight loss outcomes

Weight loss data were available for 116 patients (five lost to follow-up for weight, but HbA1c data remained complete). As illustrated in Figure 2, both bypass procedures were associated with significantly greater percentage total weight loss (%TWL) compared with LSG (one-way ANOVA $p < 0.001$). Mean %TWL was approximately 30% for RYGB and OAGB versus approximately 18% for LSG.

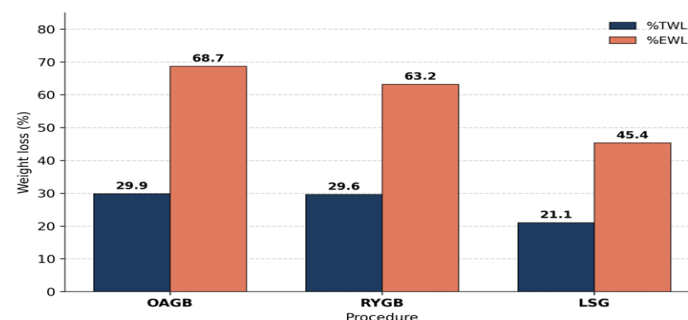


Figure 2: Mean percentage total body weight loss (%TWL) and mean percentage excess body weight loss (%EWL) by procedure at two years

RYGB and OAGB produced equivalent and significantly greater %TWL compared with LSG ($p < 0.001$). OAGB demonstrated the highest mean %EWL ($\approx 68.7\%$), followed by RYGB ($\approx 63.2\%$) and LSG ($\approx 45.4\%$)

Tukey post-hoc comparisons (Table 3) confirmed that RYGB and OAGB were superior to LSG ($p < 0.001$ and $p = 0.002$, respectively), with no significant difference between the two bypass procedures ($p = 0.995$).

For percentage excess weight loss (%EWL), OAGB showed the highest mean ($\approx 68.7\%$),

followed by RYGB ($\approx 63.2\%$) and LSG ($\approx 45.4\%$). The difference between OAGB and LSG was statistically significant ($p = 0.02$), but the difference between RYGB and LSG did not reach significance ($p = 0.06$), and OAGB versus RYGB was not significant ($p = 0.28$).

Table 3: Pairwise comparisons of mean %TWL (Tukey HSD post-hoc)

Procedure (I)	Comparator (J)	Adjusted p-value
OAGB	RYGB	0.995
OAGB	LSG	0.002
RYGB	OAGB	0.995
RYGB	LSG	<0.001
LSG	OAGB	0.002
LSG	RYGB	<0.001

Bold values indicate statistical significance at $p < 0.05$.

Discussion

In this retrospective analysis of 121 patients with T2DM and obesity followed for two years after metabolic surgery, we found that both gastric bypass procedures (RYGB and OAGB) were associated with significantly greater reductions in HbA1c and higher rates of diabetic remission compared with LSG. RYGB produced a numerically larger HbA1c reduction than OAGB, but the difference was not statistically significant. Weight loss outcomes generally favoured bypass procedures, with OAGB showing the highest excess weight loss percentage. Sex was not associated with differential glycaemic improvement.

Our findings align with several previous randomised controlled trials and meta-analyses that have reported superior glycaemic outcomes after gastric bypass compared with sleeve gastrectomy (19, 20, 21, 22). The mechanistic basis for this difference likely involves the combination of a small gastric pouch, exclusion of the duodenum and proximal jejunum, accelerated delivery of nutrients to the distal small bowel, and enhanced secretion of incretin hormones such as GLP-1 and peptide YY (23, 24). These effects are less pronounced after LSG, which relies primarily on gastric restriction and some ghrelin reduction. The comparable efficacy between RYGB and OAGB observed here is consistent with recent randomised evidence (25, 26), suggesting that both bypass configurations offer substantial metabolic benefits.

The overall diabetic remission rate of 71.9% falls within the range reported in large cohort studies and trials (27, 28), though direct comparisons are hampered by variable remission definitions. Notably, our definition did not require discontinuation of glucose-lowering medications because these data were not reliably captured. This is a limitation, and our remission rates may therefore overestimate complete, drug-free remission. Nevertheless, the relative ordering of procedures (bypass > sleeve) is unlikely to be affected by this bias.

We did not observe any significant effect of sex on glycaemic outcomes. This finding contrasts with some studies suggesting that men, who typically have higher visceral adiposity, may

experience greater metabolic benefit after bariatric surgery (15). However, those studies directly measured visceral fat using imaging, whereas we used sex as a crude proxy. Without direct measurement of visceral, subcutaneous, or epicardial fat volumes, we cannot draw any mechanistic conclusions about fat distribution. The most straightforward interpretation of our data is that, in this cohort, male and female patients achieved comparable improvements in HbA1c and remission rates. Future research should incorporate quantitative body composition analysis (e.g., CT or MRI) before and after surgery to clarify whether fat distribution independently predicts response.

Study limitations and future directions

This study has several important limitations. First, the retrospective, observational design precludes causal inference; our use of terms such as “associated with” rather than “produced” reflects this. Although groups were similar on measured baseline variables, unmeasured confounding (e.g., diabetes duration, insulin use, socioeconomic factors, surgeon preference) may have influenced outcomes. Second, the sample size is modest, particularly for the OAGB and LSG groups ($n=27$ and 26 , respectively), which limits power to detect small-to-moderate differences between bypass procedures. The non-significant trend favouring RYGB over OAGB ($p=0.361$) might become significant in a larger study, but equally it might vanish. Third, we lacked objective measures of visceral fat, medication use at follow-up, and diabetes duration, all of which are known predictors of remission. Fourth, the single-centre design limits generalisability, although standardised surgical techniques enhance internal validity. Fifth, a two-year follow-up is relatively short for assessing the durability of remission; longer-term data are needed. Finally, despite the prospective maintenance of the database, retrospective analysis introduces potential selection bias.

Future prospective, ideally randomised, studies should include comprehensive phenotyping (body composition, insulin sensitivity, beta-cell function), standardised medication protocols, and follow-up beyond five years. They should also adopt uniform remission criteria that

incorporate medication discontinuation. Incorporating imaging-based fat distribution metrics would help determine whether sex differences in visceral adiposity translate into differential metabolic outcomes.

Conclusion

Among patients with T2DM and obesity undergoing metabolic surgery, RYGB and OAGB are associated with superior glycaemic control and weight loss compared with LSG at two years. The difference between RYGB and OAGB in HbA1c reduction did not reach statistical significance in this cohort. Sex was not associated with differential glycaemic improvement. For patients whose primary goal is diabetes remission, either gastric bypass procedure appears more effective than sleeve gastrectomy. Larger, adequately powered studies with direct fat distribution measurements are warranted to refine patient–procedure matching.

List of Abbreviations

BMI: Body mass index
 %EWL: Percentage excess weight loss
 GIP: Glucose-dependent insulinotropic polypeptide
 GLP-1: Glucagon-like peptide-1
 HbA1c: Glycated haemoglobin
 HSD: Honestly significant difference
 LSG: Laparoscopic sleeve gastrectomy
 OAGB: One-anastomosis gastric bypass
 RYGB: Roux-en-Y gastric bypass
 STROBE: Strengthening the Reporting of Observational Studies in Epidemiology
 T2DM: Type 2 diabetes mellitus
 %TWL: Percentage total weight loss

Declarations

Ethics Approval and Consent to Participate

All procedures performed in this study involving human participants were in accordance with the ethical standards of the institutional research committee (Homerton University Hospital General Surgery Department) and with the 1964 Helsinki Declaration and its later amendments. The project was approved by the local general surgery department as a service evaluation. Written informed consent was obtained from all participants for the surgical procedure and for anonymised data collection.

Consent for Publication

All authors gave consent for the publication of this work under the Creative Commons Attribution Non-Commercial 4.0 license.

Data Availability

The datasets generated and analysed during the current study are not publicly available due to institutional restrictions and patient confidentiality agreements, but are available from the corresponding author on reasonable request, subject to approval from Homerton University Hospital's data access committee.

Competing Interests

The authors declare no competing interests of any kind related to this study.

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Author Contributions

AAA: Investigation, writing of the original draft, writing of the review & editing.
 HA: Conceptualisation, Methodology, Supervision, Writing of the review & editing, Project administration.
 GE: Writing of the original draft, Validation.
 KAK: Data curation, Resources.
 ZA: Investigation, Visualisation.
 HN: Formal analysis, Software.
 MM: Formal analysis, Methodology.
 YM: Data curation, Visualisation (tables and figures).
 AK: Data curation, Follow-up coordination.
 HT: Writing of the original draft, Investigation.
 AO: Investigation, Validation.
 AAN: Supervision, Writing of the review & editing.
 All authors reviewed and approved the final submitted version and agree to be accountable for all aspects of the work.

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