



Comparison of Gastrojejunal Anastomosis Techniques in Laparoscopic Roux-en-Y Gastric Bypass: Gastrojejunal Stricture Rate and Effect on Subsequent Weight Loss

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Abstract

Background Different gastrojejunal anastomotic (GJA) techniques have been described in laparoscopic Roux-en-Y gastric bypass (LRYGB). There is conflicting data on whether one technique is superior to the other. We aimed to compare hand-sewn (HSA), circular-stapled (CSA) and linear-stapled (LSA) anastomotic techniques in terms of stricture rates and their impact on subsequent weight loss.

Methods A prospectively collected database was used to identify patients undergoing LRYGB surgery between March 2005 and May 2012. Anastomotic technique (HSA, CSA, LSA) was performed according to individual surgeon preference. The database recorded patient demographics, relevant comorbidities and the type of GJA performed. Serial weight measurements and percentage excess weight loss (%EWL) were available at defined follow-up intervals.

Results Included in the data were 426 patients, divided between HSA ($n=174$, 40.8 %), CSA ($n=110$, 25.8 %) and LSA ($n=142$, 33.3 %). There was no significant difference in the stricture rates (HSA $n=17$, 9.72 %; CSA $n=9$, 8.18 %; LSA $n=8$, 5.63 %; $p=0.4006$). Weight loss was similar between the three techniques (HSA, CSA and LSA) at 3 months (40.6 %±16.2 % vs 35.92 %±21.42 % vs 48.21 %±14.79 %; $p=0.0821$), 6 months (61.48 %±23.94 % vs 58.16 %±27.31 % vs 60.18 %±22.26 %; $p=0.2296$), 12 months (72.94 %±19.93 % vs 69.72±21.42 % vs 66.05 %±17.75 %; $p=0.0617$) and 24 months (73.29 %±22.31 % vs 68.75 %±24.71 % vs 69.40 %±23.10 %; $p=0.7242$), respectively.

The stricture group lost significantly greater weight (%EWL) within the first 3 months compared to the non-

stricture group (45.39 %±16.82 % vs 39.22 %±21.93 %; $p=0.0340$); however, this difference had resolved at 6 months (61.29 %±18.50 % vs 59.79 %±23.03 %; $p=0.8802$) and 12 months (71.59 %±18.67 % vs 68.69 %±22.19 %; $p=0.5970$).

Conclusions There was no significant difference in the rate of strictures between the three techniques, although the linear technique appears to have the lowest requirement for post-operative dilatation. The re-intervention rate will, in part, be dictated by the threshold for endoscopy, which will vary between units. Weight loss was similar between the three anastomotic techniques. Surgeons should use techniques that they are most familiar with, as stricture and weight loss rates are not significantly different.

Keywords LRYGB · Gastrojejunal anastomosis · Stricture rate · Weight loss

Introduction

Obesity is a major epidemic in western society, with huge health care and economic implications [1]. It leads to serious medical complications such as diabetes, hypertension and cardiovascular disease as well as increased mortality [2–4].

Bariatric surgery, including laparoscopic Roux-en-Y gastric bypass (LRYGB) has proven to be an effective surgical procedure in achieving effective and sustained weight loss [5]. Since the introduction of LRYGB, different gastrojejunostomy anastomosis (GJA) techniques have been described, including hand-sewn (HSA), linear-stapled (LSA) and circular-stapled (CSA) techniques. Previous studies have shown conflicting evidence as to which technique is superior, if at all, in reducing the early complications [6–8].

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One of the potential complications of LRYGB is anastomotic stricture, which commonly presents with dysphagia, inability to progress to the different stages of diet, nausea and vomiting [6, 9, 10]. We aimed to study three LRYGB techniques (HSA, LSA, CSA) used in our unit over the last 7 years to assess outcomes in terms of stricture rate and requirement for anastomotic dilatation as well as weight loss.

Methods

Setting

From March 2005 to May 2012, 426 consecutive patients underwent LRYGB by three surgeons at the Bariatric and Metabolic Surgery Unit at Chelsea and Westminster Hospital NHS Trust. A prospectively collected database was used to identify patients undergoing surgery, and those requiring anastomotic dilatations. This data was cross-referenced with hospital, endoscopy and discharge records to ensure accuracy.

The unit currently carries out over 300 cases per year, including sleeve gastrectomy and laparoscopic adjustable gastric band procedures. The study period coincides with the development of the prospective database and a sharp increase in annual case load. As a result, patient numbers were smaller at the beginning of the study period, and increased with unit expansion. The hospital's Research and Development Office approved the study.

Anastomotic technique (HSA, LSA, CSA) was performed according to individual surgeon preference. The database recorded patient demographics, comorbidities, type of GJA performed and serial weight measurements at defined follow-up intervals. The optimum weight and initial excess weight were calculated using body mass index (BMI) of 25 and medium frame size as the target. Percentage weight loss was calculated at every follow-up by prospectively entering patient data into the database.

All patients underwent standardised pre-operative assessment via a specialist MDT including surgeons, anaesthetists, specialist dieticians and psychologists. Post-operative management followed a standard protocol. Smoking cessation was advised for at least 2 months prior to surgery, although nicotine test was not performed on the day of surgery for confirmation. Post operatively, our programme recommended 2 weeks of purely liquid diet followed by 3 weeks of puree diet and then gradual progression onto solid diet. Protein shakes were provided routinely for the first 3 months and as long as patients tolerated liquids and protein shakes, no dilatation was performed for 3 months. If there was inability to tolerate fluids, an earlier dilatation was considered.

Procedure

HSA technique—The pouch was constructed in a vertical fashion along the lesser curve area using a 34-Fr sizer (11 mm diameter) tube and was 10–20 ml in volume. The length of the pouch was measured at 7 cm from the oesophago-gastric junction and was 2 cm in width. During the duration of the study, three different types of stapling guns were used to transect the stomach; ETS Endoflex™, Echelon™ (Ethicon Endo-Surgery Inc, NJ, USA) and Endo GIA trisapler™ (Covidien, MA, USA).

The GJA was constructed hand-sewn in an end-to-side configuration in two continuous layers with 2.0 Vicryl (TM, Ethicon Endo-Surgery Inc, NJ, USA) over the 34 Fr oro-gastric tube for calibration giving and an anastomosis diameter of 11–12 mm. The biliopancreatic limb was 25–30 cm and the alimentary limb 100 cm. The jejuno-jejunostomy was constructed side to side with a staple gun, and the defect was closed in continuous suture 2.0 Vicryl in a single layer.

LSA technique—The gastric pouch was created using one horizontal and two to three vertical stapler lines. A side-to-side stapled anastomosis (Echelon™ linear stapler or Endo GIA trisapler™) was calibrated to approximately 30 mm. The enterotomies were hand-sewn with double layer continuous suture (2.0 Polysorb, Covidien, MA, USA).

CSA technique—After creation of the gastric pouch in a similar fashion to the LSA technique, the EEAT™ OrViI™ (Covidien, MA, USA) was introduced transorally, and the 25 mm circular stapling device was inserted into the Roux limb via a port site to create the anastomosis. The Roux limb was 100 cm in length, and the jejuno-jejunal anastomosis utilised the side-to-side stapled technique.

Routing of Roux limb was retrocolic antegastric for HSA technique in 95 % of cases with a short 25 cm biliopancreatic limb and a 100 cm alimentary limb.

In the rest, 5 % of cases creation of a window in the transverse mesocolon could not be established, and an antecolic antegastric Roux limb was constructed. The biliopancreatic limb in these cases was 60 cm and the alimentary 100 cm.

For the LSA and CSA techniques, an antecolic antegastric routing of the Roux limb was constructed.

A methylene blue dye test was performed intra-operatively to exclude anastomotic leak. Patients were followed-up by surgeons, dieticians and nurse specialists at regular intervals post operatively, with recommended follow-up dates being; 2 and 6 weeks, 3, 6, 9, 12 and 18 months and annually thereafter. At each follow-up, patients' weight was measured with BMI and percentage excess weight loss calculated. A proton pump inhibitor (PPI) was routinely prescribed for all patients for the first 3 months post-surgery.

Symptoms suggestive of a stricture (dysphagia, inability to progress from the liquid to pureed or solid diet, nausea,

vomiting and/or epigastric pain) were investigated with oesophagogastroduodenoscopy (OGD). We defined a stricture of the gastrojejunal anastomosis as one that could not accommodate the insertion of a 10-mm endoscope, in the presence of symptoms defined as above, within 90 days from surgery. The 90-day mark was chosen arbitrarily to incorporate all early strictures and exclude delayed stricture related to marginal ulceration. If an anastomotic stricture was found as suggested by the inability to pass the 10-mm endoscope through the anastomosis, it was then dilated using serial, radial dilating balloons up to a maximum of 20 mm, maintained for one minute.

Statistical Analysis

All statistical analysis was performed using GraphPad Prism™ (GraphPad Software, Inc. California, USA), with $p < 0.05$ being considered statistically significant. Categorical data was analysed using chi-squared testing. Weight loss data was assessed for distribution using the D'agostino and Pearson normality test. Parametric data was analysed using three-way ANOVA comparison. Non-parametric data utilised the Kruskal-Wallis test.

Results

The demographics of all three GJA techniques were similar with an average age of 43 years, and the majority of patients being female gender (81–87%) (Table 1). Our data shows that there was no statistically significant difference between the three different techniques (HSA 9.72 %, CSA 8.18 %, LSA 5.63 %; p value=0.4006) (Table 2) in terms of stricture rate.

There was no statistical difference in the percentage of excess weight loss (%EWL) between the three GJA techniques at 3, 6, 12 and 24 months post operatively (Table 3). Weight loss at 12 months was; HSA 72.94±19.93 %, CSA 69.72±21.42 % and LSA 66.05±17.75 %, which is comparable to large series in literature. Follow-up rate was 93 % at 3 months, 90 % at 6 months, 83 % at 12 months and 60 % at 24 months, similar between operative approaches.

Table 1 Demographics of the study

	Hand-sewn	Circular	Linear
Patients (<i>n</i>)	174 (40.8 %)	110 (25.8 %)	142 (33.3 %)
Age (years)	42.7	44.5	41.3
Sex (F/M)	141/33 (81/19 %)	94/16 (85.5/14.5 %)	123/19 (86.6/13.4 %)
Smokers	26 (14.9 %)	21 (19.1 %)	24 (16.9 %)
Diabetes	48 (27.6 %)	29 (26.4 %)	27 (19 %)
Hypertension	69 (39.7 %)	38 (34.5 %)	37 (26.1 %)

Table 2 Post-operative GJA strictures following LRYGB, comparing three different techniques

	Hand-sewn	Circular	Linear	<i>p</i> value
Patients (<i>n</i>)	174	110	142	-
Strictures	17 (9.72 %)	9 (8.18 %)	8 (5.63 %)	0.4006

Patients who developed strictures lost significantly more weight compared to those who did not have any strictures (Table 4), a difference that was not maintained beyond 3 months following surgery. The majority of patients who had GJA strictures were able to achieve adequate symptom relief from first dilatation alone (64 %), whilst 10 % needed a second dilatation and 16 % a third dilatation (Table 5).

Discussion

Our study of 426 consecutive patients undergoing LRYGB has demonstrated no statistical difference between the three techniques both in terms of stricture rate and weight loss up to 2 years after surgery.

Our prospectively collected data compared three different anastomotic techniques used at a single institution. Peri-operative protocols and follow-up rates of patients were identical allowing for meaningful comparison. This study is one of a few studies to compare anastomotic stricture rate for all three surgical techniques directly and unlike the others has also examined short-term weight loss outcomes. The rate of overall stricture in our study was comparable to the other literature currently available [6–10].

Weight loss after gastric bypass is a complex process. True assessment requires matching of demographics in a randomised control trial setting plus standardising pouch size, anastomotic size and limb lengths. This was a non-randomised trial; therefore, although the groups are similar in their characteristics, it is impossible to completely eliminate variations. Although attempts were made to standardise criteria for dilatation, threshold for endoscopy will inevitably vary making it difficult to compare different units' stricture

Table 3 Comparison of percentage excess weight loss between three different GJA techniques at different follow-up periods, EWL (excess weight loss)

	Hand-sewn	Circular	Linear	<i>p</i> value
Patients (<i>n</i>)	174	110	142	–
EWL (%) 3 months	40.6±16.2	35.92±21.42	48.21±14.79	0.0821
EWL (%) 6 months	61.48±23.94	58.16±27.31	60.18±22.26	0.2296
EWL (%) 12 months	72.94±19.93	69.72±21.42	66.05±17.75	0.0617
EWL (%) 24 months	73.29±22.31	68.75±24.71	69.40±23.10	0.7242

rates after surgery. It is likely that we have underestimated the true stricture rate in this cohort of patients, an inherent problem encountered when using patients' description of their symptoms as an indication for endoscopy. Undoubtedly, some patients with weight loss, contributed to in part by an anastomotic stricture, will perceive this as a desirable outcome and as a result under-report their symptoms. The only way to exclude this potential confounder would be to standardly perform endoscopic or radiological assessment of each patient with defined criteria, an algorithm which some might argue would over investigate the majority of patients, who will not have evidence of a stricture.

This study examined weight loss up to 2 years following surgery and therefore cannot speculate on whether longer term follow-up would also demonstrate no differences between anastomotic technique and weight loss. For example, other anastomotic complications such as stoma dilatation and fistula formation have been implicated in long-term weight regain after surgery but may remain occult without adequate duration of follow-up [11, 12].

A survey in the USA has shown the proportions of three main anastomotic techniques being used; hand-sewn (HSA), linear-stapled (LSA) and circular-stapled (CSA); 21, 41 and 43 %, respectively. These techniques are the subject of much debate with regard to complication rate and efficacy [13]. Many studies have looked at stricture rates between the different anastomotic techniques but with conflicting results. Factors such as surgeon experience, small study size and differing surgical post-operative care make these results difficult to interpret confidently.

Bandewald et al. (2011) showed no significant difference in the stricture rates between the CSA (4.3 %), HSA (6.1 %)

and LSA groups (6.0 %) [6]. However, a possible drawback was the inconsistency between their groups in the use of ulcer prophylaxis following surgery. Gonzalez et al. (2003) found that GJA were significantly more common with CSA (30.7 %) than HSA (3.5 %) or LSA (0 %) [7]. However, this may be due to the use of a 21-mm circular stapler, which has since been shown to be inferior to the 25-mm version [14]. The Abdel-Galil and Sabry (2002) study found conflicting results with strictures being more common in the HSA group (33.3 %) than CSA (16.7 %) or LSA group (10.0 %) [8]. Interpretation of this study is also limited, as the authors did not report on the size of the circular stapler used.

Bohdjalian et al. (2010), which compared %EWL in CSA and LSA groups, had comparable results, apart from the first 3 months, where they found significantly greater percentage EWL of 36.6±11.4 % in CSA group compared to 30.3±12.4 % in LSA group [15]. However, our study showed that patients who had strictures had statistically significant %EWL compared to those who did not at 3 months after surgery, but that effect disappeared at 6 months. This can be explained by the fact that patients who had strictures suffered from symptoms of dysphagia, nausea and vomiting which would have reduced their oral intake resulting in greater excess weight loss, compared to the non-stricture group who did not suffer from these symptoms. Whether this, in itself, confirms that restriction is at least a component of successful bypass surgery is debatable.

In conclusion, we have shown in this large series of single-institution procedures that anastomotic technique has no significant impact on stricture rate or weight loss. Each technique has advantages and disadvantages, and therefore, surgeons can confidently perform whichever technique they prefer with no detrimental effect on short-term outcomes.

Table 4 Comparison of percentage excess weight loss between LRYGB with strictures vs non-strictures at different follow-up periods

	Stricture	Non-stricture	<i>p</i> value
Patients (<i>n</i>)	34	392	–
EWL (%) 3 months	45.39±16.82	39.22±21.93	0.0340
EWL (%) 6 months	61.29±18.50	59.79±23.03	0.8802
EWL (%) 12 months	71.59±18.67	68.69±22.19	0.5970

Table 5 Number of dilatations required for each GJA technique leading to satisfactory symptom relief

No. of dilatations required	Hand-sewn	Circular	Linear	Total
1	11	5	4	20
2	2	0	1	3
3	4	1	3	8
>4	0	3	0	3

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Conflict of Interest None of the authors have a potential conflict of interest.

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