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COMPARISON OF LINEAR VERSUS CIRCULAR STAPLING TECHNIQUES IN LAPAROSCOPIC GASTRIC BYPASS SURGERY – A PILOT STUDY

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ABSTRACT

Background: **There is major variability in how the gastrojejunostomy (GJ) is created when laparoscopic gastric bypass (LRYGB) is performed. This is a prospective, non-randomised pilot comparison of two different techniques during our learning curve period performed by two different surgeons with similar surgical experience.**

Methods: **From March 2006 until May 2008, 71 consecutive patients, 28 men and 43 woman, mean age 44 (range 24 to 62 years) who were operated for morbid obesity by laparoscopic bypass surgery have been included. Mean preoperative Body Mass Index (BMI) (range) was 47 (34–63). The patients were divided into two groups on the basis of the stapler used. Group 1 comprised 30 patients who underwent surgery using a 25 mm circular stapler to create the GJ. Group 2 comprised 41 patients who underwent surgery using a 45 mm, blue cartridge linear stapler. Operative time, intra-operative complications, hospital stay, major and minor complications were detected.**

Results: **Intra-operative complications occurred in 4 patients (13.3%) in Group 1, in 5 patients (12.2%) in Group 2. Re-operations occurred 3 times (10.0%) in Group 1, and 4 times (9.8%) in Group 2 due to anastomotic complications, bleeding and/or bowel obstruction. Major complications occurred in four patients in Group 1 (13.3%) and in seven patients in Group 2 (17.1%). There was a significant difference in the overall morbidity rate (major and minor complications), which was 56.7% in Group 1 and 34.1% in Group 2 ($p = 0.05$). Mean operative time in Group 1 was 135 minutes, and in Group 2 122 minutes. Mean hospital stay was significantly shorter in Group 2 (3.9 days) than in Group 1 (5.7 days, $p = 0.04$).**

Conclusions: **Learning to handle the technique when performing the gastrojejunostomy during laparoscopic gastric bypass surgery may be faster and easier by using the linear stapler. This may be important knowledge for centres considering starting LRYGB practice, although the surgeon factor needs to be taken in account.**

The results should be interpreted with caution because the confounding effect of one surgeon performing one type of operation while the other surgeon (is performing) the second type of operation could not be taken into account in this prospective non-randomized analysis.

Key words: Linear stapler; circular stapler; Roux-en-Y gastric bypass; gastro-jejunostomy; morbid obesity; learning curve

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INTRODUCTION

Since its first description in 1994 by Wittgrove et al. (1) laparoscopic Roux-en-Y gastric bypass (LRYGB) is one of the most common operations for the treatment of morbid obesity. Early complications are not uncommon, occurring in 10–30% of patients, especially during the learning period. They include: anastomotic leak, obstruction, bleeding, dilatation of the bypassed stomach and other peri-operative complications such as deep vein thrombosis, pulmonary embolus, myocardial ischemia, etc. Late complications include anastomotic stricture, small bowel obstruction due to adhesions or internal hernia, cholelithiasis, inadequate weight loss and nutritional deficiencies (2–6).

There is major variability in how the gastro-jejunostomy (GJ) is created when LRYGB is performed. It can be performed as a totally hand-sewn procedure, mechanically using linear or circular stapler, with different outcomes and complications, both in the early postoperative period and throughout the follow-up.

In the United States the percentage of surgeons using the circular stapler, linear stapler, and hand sewing is 43%, 41% and 21% for the GJ technique (7).

At least three previous studies have compared the circular stapling technique with the linear stapling technique for the GJ anastomosis with different results (8, 9, 10).

Previous studies suggest that the learning curve includes 100 cases for reaching morbidity rate similar to open procedures, or a significant reduction in morbidity (11, 12). Laparoscopic bypass surgery for morbid obesity was started at our hospital in March 2006.

The purpose of this study was to compare our early outcomes of laparoscopic gastric bypass surgery after formation of the GJ anastamosis with either circular or linear endoscopic staplers during the learning curve period.

PATIENTS AND METHODS

From March 2006 until May 2008, 71 patients, 28 men and 43 woman, who ranged from 24 to 62 years of age (mean 44) and who were scheduled for laparoscopic bypass surgery for morbidity obesity have been included in this study.

TABLE 1

Demographics of patients at time of study.

	Group 1 (n = 30)	Group 2 (n = 41)	P-value*
Age (mean ± SD)	44.71 ± 9.27	43.01 ± 11.16	> 0.05
Sex ratio (F:M)	19:11	24:17	> 0.05**
Mean weight (kg)	133.6 ± 20.7	141 ± 25.74	> 0.05
BMI (kg/m²)	45.57 ± 6.43	47.67 ± 6.86	> 0.05
Excess weight (kg)	60.04 ± 18.55	67.15 ± 21.95	> 0.05
Excess weight (%)	80.87 ± 26.45	90.69 ± 27.44	> 0.05

* Student's T test. ** Fisher's Exact Test.

Patient characteristics are outlined in Table1. Seventy patients (98.6%) suffered from one or more of the most typical co-morbid conditions associated with heavy overweight (high blood pressure, diabetes, hypercholesterolemia, sleep-apnea, gastroesophageal reflux disease -GERD-). Forty patients (56.3%) had diabetes type II.

The patients were divided into two groups on the basis of the stapler used in constructing the GJ. Group 1 comprised 30 patients who underwent surgery using a 25 mm circular stapler (Covidien, Norwalk, Connecticut, USA). Group 2 comprised 41 patients who underwent surgery using a 45 mm, blue cartridge linear stapler (Covidien, Norwalk, Connecticut, USA). The two groups were comparable (Table 1).

Two surgeons (PT and MV) performed all the operations and always together. Both being experienced laparoscopic surgeons with more than 10 years experience of laparoscopic gastric bandings and even longer experience with other laparoscopic gastro-intestinal surgery. As the other (PT) preferred the circular technique and the other (MV) the linear technique both techniques were used from the very beginning in a non-randomised fashion. We took turns as first or second surgeon and the technique used depended on who happened to be the first surgeon. Visits to several large European bariatric centres was done before we started.

Operative time, intra-operative complications (such as conversion to open, perforation, bleeding and anastomotic complications), hospital stay, major and minor complications were detected. Major complications were defined as either life-threatening complications or complications that required re-hospitalization and/or re-operation. Minor complications were defined as complications managed at outpatient clinic and/or with medications.

OPERATIVE TECHNIQUE AND PERIOPERATIVE MANAGEMENT

LRGYB was performed using a 5-trocar technique in both Groups.

In the circular-stapler group, the gastric pouch is made on the lesser curvature of the stomach in continuation with the oesophagus. An incision is made at the lower medial corner of the pouch, away from the lesser curvature, using electro coagulating blade or scissors. A nasogastric tube connected to a circular stapler-25 Anvil is introduced through the mouth and pulled into position in the pouch. Once the anvil is adjusted to the pouch, we verify that the opening around the stem is tightly closed with a purse-string suture.

The circular stapler is introduced through the left upper quadrant of the abdomen and inserted in the afferent jejunal loop. Activating the mechanism of the stapler, and bringing the pin out of the jejunum, the anastomosis is made end to side. The anvil is approximated to the main circular stapler instrument. After it has been squeezed, and the circular anastomosis is completed, the instrument is withdrawn through the same opening that was used when it was introduced and the opening is closed with a linear 45 mm cartridge, white load. The donuts of the tissue is removed with the circular stapler and examined, to assure the integrity of the anastomosis.

In the linear stapler group, a fully transected lesser curvature vertical pouch was created using 45 mm and 60 mm blue cartridges. The antecolic antegastric gastro-jejunostomy was then created using a 45 mm blues cartridge. The resultant enterotomy was closed with a hand-sewn, 2 layer, absorbable running suture.

The jejuno-jejunostomy was created using a 60 mm,

white cartridges side to side and the enterotomy was closed with a running suture in one layer.

In both groups anastomotic integrity was tested with 100 ml methylene blue. Biliary limb was measured to 50 cm, Roux alimentary limb to 150 cm. No drains were placed.

All patients were extubated immediately after surgery. They were admitted to the surgical ward after follow-up in the awakening room until next morning. A liquid diet was initiated the first postoperative day if no signs of complications could be detected. The patients were followed at regular intervals postoperatively, with the first outpatient visit at 6 weeks.

STATISTICAL ANALYSIS

Statistical analysis has been performed using a SPSS statistical software (SPSS 16.0.1, Chicago, Illinois 60606, U.S.A).

Fisher's Exact test was used to compare proportions between groups and Student's t test was used to compare continuous variables. A $p < 0.05$ was considered as statistically significant.

RESULTS

Intra-operative complications occurred in 4 patients (13.3%) in Group 1, in 5 patients (12.2%) in Group 2. One patient in the Group 1 required conversion to open surgery because of difficulties in constructing the enteroanastomosis. Three patients in the Group 2 had more than one intra-operative complication (Table 2). However, all intra-operative complications were managed without further sequel.

Re-operations occurred 3 times in Group 1 due to anastomotic leakage (two patients) and bowel occlusion (one patient), and 4 times in Group 2 due to GJ anastomotic leakage (one patient), blow-out of the bypassed stomach (one patient) and haemorrhage (two patient).

One death occurred in Group 2 because of septic complications following rupture of the bypassed stomach (blow-out) on the third postoperative day.

Complications were divided in major and minor occurrences. Major complications rates in Group 1 and in Group 2 were 13.3% and 17.1% respectively. Postoperative complications are listed in Table 3.

There was a significant difference in the overall morbidity rate (major and minor complications), which was 56.7% in Group 1 versus 34.1% in Group 2 ($p = 0.05$), giving an overall morbidity rate of 43.7% in the whole group (Table 3).

No significant difference was detected in mean operative time while mean hospital stay was significantly shorter in Group 2 than in Group 1 ($p = 0.04$, Table 4).

TABLE 2

Intra-operative complications.

	Group 1 (n = 30)	Group 2 (n = 41)	P-value*
Conversion to open	1 (3.33%)	0 (%)	> 0.05
Perforation	1 (3.33%)	3 (7.32%)	> 0.05
Bleeding	0 (0%)	1 (2.44%)	> 0.05
Anastomotic complications	2 (6.67%)	4 (9.76%)	> 0.05
Total patients	4 (13.33%)	5 (11.9%)**	> 0.05

* Fisher's Exact Test.
** 3 patients had more than one intra-operative complication.

TABLE 3

*Postoperative complications.***

	Group 1 (n = 30)	Group 2 (n = 41)	P-value*
Patients with complications	17 (56.67%)	14 (34.15%)	0.050
Overall number of complications	20	17	0.016
Patients with major complications	4 (13.33%)	7 (17.07%)	> 0.05
Total major complications	4	8	
Mortality	0 (0%)	1 (2.44%)	> 0.05
Anastomotic leak	2 (6.67%)	2 (4.88%)	> 0.05
Jejuno-jejunostomy	2	1	
Gastro-jejunostomy	0	1	
Haemorrhage	2 (6.67%)	4 (9.76%)	> 0.05
Pulmonary emboli	0 (0%)	1 (3.45%)	> 0.05
Patients with minor complications	14 (46.67%)	9 (21.95%)	0.026
Total minor complications	16	9	
Anastomosis stricture	4 (13.33%)	2 (4.88%)	0.157
Ulcus marginalis	1 (3.33%)	2 (2.44%)	> 0.05
Wound infection	9 (30%)	5 (12.19%)	0.060
Pneumonia	1 (3.33%)	0 (0%)	> 0.05
Ileus	1 (3.33%)	0	> 0.05

* Fisher's Exact Test.

** One patient in Group 1 had 1 major and 2 minor complications.
One patient in Group 1 had 1 minor and 1 major complication.
One patient in Group 1 had 2 minor complications.
One patient in Group 2 had 2 major complications.
Two patients in Group 2 had 1 minor and 1 major complication.

TABLE 4

Comparison of peri-operative parameters Group 1 and Group 2 patients.

	Group 1 (n = 30)	Group 2 (n = 41)	P-value*
Operative time (min, mean ± SD)	135.07 ± 28.3	121.64 ± 33.24	0.09
Hospital stay (days, mean ± SD)	5.72 ± 5.31	3.9 ± 2.98	0.04

* Student's T test.

DISCUSSION

In this study we showed our results with LRYGB during the learning curve period. Shikora et al. (12) described a morbidity rate of 11–13% after the first 100 cases, indicating a potential number for reaching a low, stable and acceptable morbidity rate after LRYGB with growing experience. Previous recent reports described an up to 30% complication rate during the learning curve period (2–6). In our short case series we showed a slightly higher overall complication rate, especially concerning the circular stapler LRYGB Group.

Analysing three techniques, Gonzales et al. (8) reported 31% stenosis for circular mechanical anastomoses, 0% for linear and 3% for hand-sewn while Abdel-Galil et al. (9) reported 16% for circular mechanical anastomoses, 10% for linear, and 33% for hand-sewn; and Lujan et al. (13) reported 1.1% rate of stenosis for circular mechanical anastomoses.

We observed a stenosis rate of 13.3% for circular and 4.9% for linear stapler technique during the learning curve period. This is in line with the preliminary data from a prospective randomised trial in Belgium were the stricture rate following circular stapled anastamosis was 8.3% and 1.0% following the linear stapled anastamosis (Cadiere BG. Personal communication. 7th International Obesity Surgery Expert Meeting, Saalfelden, Austria, 8–11 April 2009).

Our re-operation rate of 10.0% in Group 1 and 9.8% in Group 2 is higher than the one presented in other series of LRYGB during a learning period, which ranges from 1% to 8.4% (2–6). This our very high rate might be due to technical difficulties during the learning curve.

The only death occurred near the beginning of our experience with LRYGB in Group 2. The patient was almost completely asymptomatic until a sudden intense pain occurred and deep septic shock soon after. She was immediately re-operated and a rupture in the bypassed stomach was found (blow out) due to an obstructing blood clot in the entero-anastamosis. She died from septic complications three weeks later. The idea of putting in a tube in the remnant stomach in everyone can avoid this, usually fatal and rare complication, but despite the earlier recommendations of M. Fobi (14), this idea has not gained wider acceptance. However, mortality after bariatric surgery is a rare event: published rates of postoperative mortality range from 0.05% to 2%. In a recent report on a large population (15) mortality was 0.25% at sixty days and significant risk factors were open surgery, conversion to open surgery and prolonged operative time. According to the meta-analysis of Buchwald et al. (16), the 30 day mortality following LRYGB was 0.16%.

Circular stapled anastomosis with trans-oral anvil insertion for the creation of the gastrojejunostomy in LRYGB are associated with frequent infections at the abdominal wall site where the stapler is inserted. Especially trocar site infection is one main disadvantages of the circular-stapled technique for the GJ (10, 14, 17). Our post-operative wound infection rate is pretty high, and even higher in the circular stapler group (30% vs 12.2%, p = 0.06). One possible explanation for this finding might be learning curve-related. However, with further experience this rate has fallen to near zero.

The optimal bariatric operation for morbidity obesity is still arguable. In a recent study, Madan et al. (7) reported on the preferred surgical technique for GJ: 43% of the surgeons perform a circular-stapled GJ, while 41% prefer linear stapling, and 21% prefer the totally hand-sewn GJ. Thus, distribution of these surgical techniques indicates that no surgical technique seems superior to the other.

There is no standard technique for creating the gastrojejunostomy in LRYGB. Although the incidence of complications reported for the circular stapler technique is low, the use of linear stapler during the learning curve period may permit a lower complications rate. In other words, the linear stapling technique may be easier and faster to learn.

This study shows the learning curve for two different surgeons doing their very first laparoscopic gastric bypasses, one doing the linear GJ and the other one the circular. In this way, neither surgeon had to mix two techniques during the learning period. Any difference in outcomes between the two techniques can perhaps be explained by the surgeons factor. However, both circular- and linear-stapled anastomosis were performed with surgical comparable experience and all operations were performed by both surgeons together.

This was a pilot study including only a few patients merely showing that there may be some differences in outcomes depending on selected technique during the learning period. A prospective, randomised comparison of the two techniques may prove an advantage of one technique over the other after the learning period. Such a study is now ongoing in Finland.

CONCLUSIONS

Sophisticated surgical procedures like LRYGB are continuously improving by introduction of new techniques for different parts of the operation. For the establishment of the gastrojejunostomy, neither linear stapling, circular stapling, nor totally hand sewing of the anastomosis has turned out to be superior to the other techniques.

According to our preliminary results, the linear stapling technique for constructing the gastro-jejunal anastomosis may present several advantages compared to the circular stapling technique, at least during the learning curve period: reduced overall morbidity and reduced hospital stay. Any general application of these data should be preceded by enough large similar trials in prospective randomised settings after completion of the learning period and with a longer follow-up.

The results should be interpreted with caution because the confounding effect of one surgeon performing one type of operation while the other surgeon (is performing) the second type of operation could not be taken into account in this prospective non-randomized analysis.

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