



and Other Interventional Techniques

Does establishing a bariatric surgery fellowship training program influence operative outcomes?

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Received: 22 December 2005/Accepted: 3 April 2006/Online publication: 6 September 2006

Abstract

Background: Roux-en-Y gastric bypass (RYGB) has a long learning curve that may be reflected in operative outcomes. This study sought to assess whether training a fellow has an impact on the operative outcomes of the training program.

Methods: Prospectively collected data on 150 consecutive patients were compared before (group 1) and after (group 2) establishment of a fellowship-training program.

Results: A greater number of patients underwent laparoscopic RYGB (LRYGB) in group 2 than in group 1 (63% vs 46%; $p = 0.01$). The group 2 patients were similar to the group 1 patients in terms of age, gender, length of stay, and complication rate. However, they had a higher body mass index (BMI) (median 50 kg/m²; range, 39–64 kg/m² vs median, 46 kg/m²; range, 38–56 kg/m²; $p = 0.01$) and a higher incidence of prior abdominal procedures (21% vs 7%; $p = 0.006$). In addition, operative time was significantly shorter for the patients who underwent open RYGB (ORYGB) (median, 150 min; range, 65–280 min vs median, 110 min; range, 50–210 min; $p < 0.001$) and LRYGB (median, 202 min; range, 105–450 min vs median, 134 min; range, 50–191 min; $p < 0.001$) in group 2 than for the patients in group 1. The patients who underwent ORYGB in groups 1 and 2 had similar characteristics and outcomes. Increasing experience with both ORYGB and LRYGB correlated with a decrease in operative times for group 2 ($p < 0.001$), but not for group 1.

Conclusion: Establishment of a fellowship program shortens the operative times for both open and laparoscopic RYGB and expands the scope of bariatric

practice by compounding the experience of the operating team without increasing complications.

Key words: Clinically significant obesity — Complications — Experience — Fellowship training — Learning curve — Outcomes — Roux-en-Y gastric bypass

Obesity has reached epidemic proportions in North America. As a result, the number of bariatric procedures performed has risen exponentially over the past few years. It is estimated that more than 160,000 Roux-en-Y gastric bypass (RYGB) procedures were performed in 2004 alone. Currently, there are not enough fully trained bariatric surgeons to meet the increasing demand for weight loss surgery. Therefore, as with many other surgical specialties, the technically demanding nature of RYGB has driven surgeons to pursue additional supervised and formal fellowship training.

High-volume bariatric practices have established fellowship programs to train surgeons in advanced laparoscopic techniques and in the pre- and postoperative management of patients undergoing weight loss surgery. These fellowship programs encompass a learning curve of both the experienced surgeon accustomed to performing these operations, who now must relinquish the position of primary surgeon for a role of teaching a first assistant, and the trainee who must overcome a long learning curve for RYGB, reported to be 75 to 100 procedures [8, 11, 16].

It is uncertain whether all the changes and learning involved in starting a fellowship training program will have any effect on the outcomes previously attained by the experienced attending surgeon. This study aimed to evaluate whether training a fellow in bariatric surgery has any impact (either negative or positive) on the operative outcomes of an already established bariatric surgery program.

Methods

This study was approved by The University of South Florida College of Medicine Institutional Review Board (IRB) and conducted in accordance with Health Insurance Portability and Accountability Act (HIPAA) regulations. Patients undergoing primary RYGB fulfilled the criteria established by the National Institutes of Health (NIH), including the requirement that they must have a BMI of 40 kg/m² or more or a BMI of 35 kg/m² or more together with life-threatening obesity-related comorbidities. Patients who underwent revisional procedures for previously failed or complicated bariatric operations also were included in this study. All patients were required to undergo evaluation by our interdisciplinary obesity treatment group including a bariatrician, a psychologist, a nutritionist, a pulmonologist, and a surgeon.

We started the bariatric surgery program at our institution in 1998. Before starting the bariatric fellowship program in 2003, a total of 660 open and laparoscopic RYGBs had been undertaken by one attending surgeon (M.M.M.) as the primary surgeon assisted by a chief resident. Laparoscopic RYGB was introduced in mid-1999, and more than 250 procedures had been undertaken before the bariatric fellowship-training program was established. We compared data collected prospectively for the last 150 consecutive patients undergoing RYGB before establishment of the bariatric surgery fellowship training program at our institution (group 1) and on 150 consecutive patients undergoing RYGB after its establishment (group 2).

We evaluated patient demographics including age, gender, weight, BMI, and incidence of previous abdominal procedures. The operative data included operative time, estimated blood loss, and conversion from laparoscopic to open surgery. The outcomes included length of hospitalization, complications (early and late), and mortality. The procedures were further divided into open RYGB (ORYGB) and laparoscopic RYGB (LRYGB) procedures, and outcomes were compared between the two groups. We routinely perform a cholecystectomy and a liver biopsy for all patients during RYGB. Other technical aspects of the procedure remained unchanged during the study period.

Statistical analysis

Data were prospectively collected and stored electronically in our bariatric surgery database (ZBMI Data Solutions, Tampa, FL, USA). Continuous parametric data were compared using a two-tailed Student's *t*-test. Continuous nonparametric data were compared using a two-tailed Mann-Whitney *U* test. Original data were compared using a two-tailed Fisher's exact test. Linear regression was used to evaluate the correlation between the number of RYGB procedures (experience) and the operative outcomes. A *p* value less than 0.05 was considered statistically significant.

Results

Group 1

Of the last 150 consecutive RYGB patients before establishment of the bariatric surgery fellowship program, 81 (54%) underwent ORYGB and 69 (46%) underwent LRYGB. The procedures all were performed by the attending surgeon with a senior resident as an assistant.

Group 2

A total of 150 RYGBs were undertaken and managed by the fellow as the primary surgeon, with the attending surgeon as the first assistant. This group included 55 patients (37%) who underwent ORYGB and 95 patients

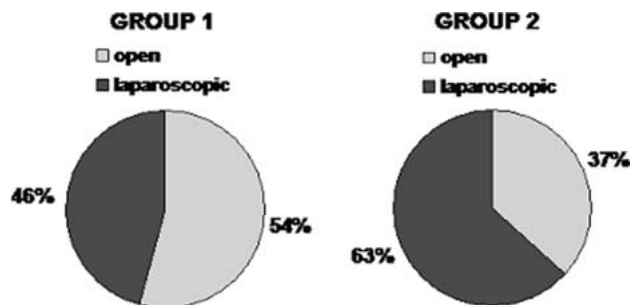


Fig. 1. The percentage of laparoscopic procedures increased significantly after initiation of a bariatric surgery fellowship program (46% vs 63%; $p = 0.01$; group 1 vs group 2).

(63%) who underwent LRYGB. A significantly greater number of patients were approached using the laparoscopic technique in group 2 than in group 1 ($p = 0.01$).

Revisional procedures

Of the 81 patients in group 1 undergoing ORYGB, 8 (10%) underwent revisional operations for failed previous bariatric procedures, including conversion of a vertical banded gastroplasty to RYGB ($n = 5$) and revision of RYGB ($n = 3$). Of the 55 patients in group 2 undergoing ORYGB, 15 (27%) underwent revisional procedures including revision of RYGB ($n = 5$) or conversion of vertical banded gastroplasty ($n = 7$), loop gastric bypass ($n = 2$), and LapBand ($n = 1$) to RYGB. A significantly greater number of patients underwent revisional procedures in group 2 than in group 1 ($p = 0.01$).

Incidence of comorbidities

A significantly greater number of obesity-related comorbidities were experienced by patients undergoing ORYGB (81%) than by patients undergoing LRYGB (57%) in group 1 ($p = 0.004$). This corresponded to the higher incidence of obstructive sleep apnea, hypertension, and mechanical problems ($p < 0.001$). However, there was no difference in the incidence of comorbidities between the patients undergoing ORYGB (86%) and those undergoing LRYGB (79%) in group 2.

Open Roux-en-Y gastric bypass

The characteristics and operative outcomes of the patients who underwent ORYGB are summarized in Table 1. The patients in groups 1 and 2 were similar in terms of age, gender distribution, weight, BMI, and incidence of previous abdominal procedures. Additionally, there was no statistically significant difference in the lengths of hospital stay, the estimated blood losses, and the complication rates between the patients undergoing ORYGB between the two groups. In contrast, the operative times for ORYGB in group 2 were significantly shorter than in group 1 ($p < 0.001$).

Table 1. Comparison of characteristics and operative outcomes of patients undergoing open Roux-en-Y gastric bypass surgery before (group 1) and after (group 2) establishment of a bariatric surgery fellowship training program^a

	Group 1 (n = 81)	Group 2 (n = 55)	p Value
Age (years)	45 (24–70)	48 (20–70)	NS
Male gender: n (%)	26 (32)	11 (20)	NS
Weight (kg)	155 (111–267)	142 (108–285)	NS
BMI (kg/m ²)	54 (39–79)	51 (39–94)	NS
Prior abdominal procedures: n (%)	18 (22)	15 (28)	NS
Estimated blood loss (ml)	250 (100–1000)	250 (100–600)	NS
Operative time (min)	150 (64–280)	110 (50–210)	<0.001
Complications: n (%)	23 (28)	11 (20)	NS
Length of stay (days)	5 (3–87)	5 (3–28)	NS

NS, not significant; BMI, body mass index

^a Data are presented as median (range)

Table 2. Comparison of patient characteristics and operative outcomes of patients undergoing laparoscopic Roux-en-Y gastric bypass surgery before (group 1) and after (group 2) establishment of a bariatric surgery fellowship training program^a

	Group 1 (n = 69)	Group 2 (n = 95)	p Value
Age (years)	46 (27–68)	43 (21–69)	NS
Male gender: n (%)	4 (6)	10 (11)	NS
Weight (kg)	130 (95–159)	151 (106–190)	0.01
BMI (kg/m ²)	46 (38–56)	50 (39–64)	0.01
Prior abdominal procedures: n (%)	5 (7)	20 (21)	0.006
Estimated blood loss (ml)	200 (100–500)	200 (100–600)	NS
Operative time (min)	202 (105–450)	134 (50–191)	<0.001
Conversion to open: n (%)	3 (4)	0	NS
Complications, patients (%)	14 (20)	15 (16)	NS
Length of stay (days)	4 (2–17)	4 (2–24)	NS

NS, not significant; BMI, body mass index

^a Data are presented as median (range)

Laparoscopic Roux-en-Y gastric bypass (LRYGB)

The characteristics and operative outcomes of the patients who underwent LRYGB are summarized in Table 2. The patients in groups 1 and 2 were similar in terms of age and gender distribution. However, the patients in group 2 had significantly greater weight, BMI, and incidence of previous abdominal procedures statistically, than the patients in group 1 ($p \leq 0.01$). In terms of outcomes, the patients in groups 1 and 2 had similar estimated blood losses, lengths of hospital stay, and complication rates. However, the operative times for LRYGB in group 2 were significantly shorter than in group 1 ($p < 0.001$). Although there was no conversion from LRYGB to ORYGB in group 2, this was not significantly different from the experience of group 2.

Operative times

Figure 2 depicts the operative times for the patients undergoing ORYGB before and after establishment of the bariatric surgery training program. The median operative time decreased from 150 min (range, 64–280 min) in group 1 to 110 min (range, 50–210 min) in

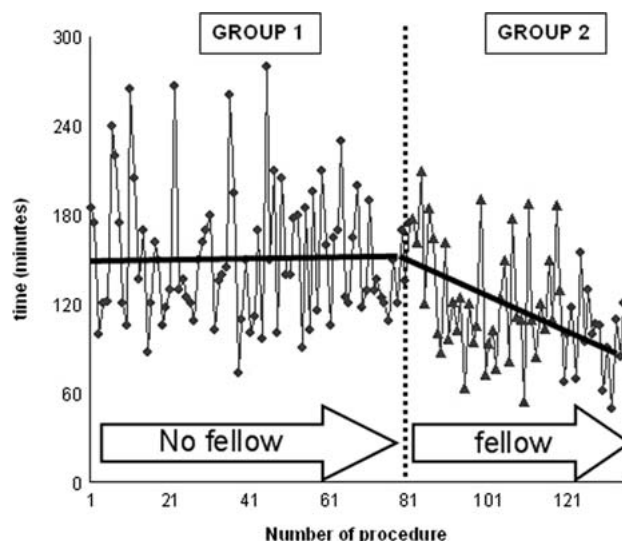


Fig. 2. Comparison of operative times for patients undergoing open Roux-en-Y gastric bypass before (group 1) and after (group 2) establishment of a bariatric surgery fellowship training program. The trend line (gray) demonstrates the reduction in operative times as the number of procedures increased. There was a statistically significant correlation between an increasing number of procedures and a reduction in operative times only after establishment of the fellowship (group 2; $p < 0.05$; $r^2 = 0.09$).

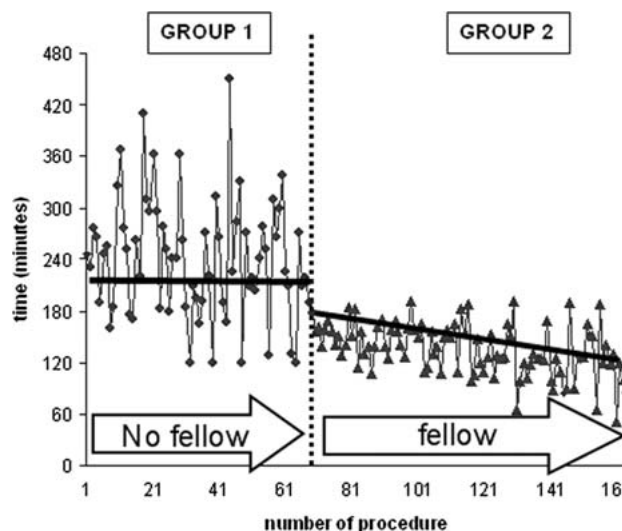


Fig. 3. Comparison of operative times for patients undergoing laparoscopic Roux-en-Y gastric bypass before (group 1) and after (group 2) establishment of a bariatric surgery fellowship training program. The trend line (gray) demonstrates the reduction in operative times as the number of procedures increased. There was a statistically significant correlation between an increasing number of procedures and a reduction in operative times after establishment of the fellowship (group 2; $p < 0.001$; $r^2 = 0.17$).

group 2 ($p < 0.001$). There is a significant correlation between the increasing number of procedures and the decrease in operative times for the patients who underwent ORYGB in group 2 ($p < 0.05$; $r^2 = 0.09$; 95% confidence interval [CI], -1.58 to -0.03). However, there was no correlation between the number of procedures and the operative times for patients who underwent ORYGB in group 1.

Table 3. Comparison of early complications of patients undergoing open and laparoscopic Roux-en-Y gastric bypass before (group 1) and after (group 2) establishment of a bariatric surgery fellowship training program

	Group 1		Group 2	
	Open <i>n</i> (%)	Laparoscopic <i>n</i> (%)	Open <i>n</i> (%)	Laparoscopic <i>n</i> (%)
Wound infection	11 (13)	2 (3)	6 (11)	3 (3)
Anastomatic leaks	2 (2.5)	3 (4)	1 (2)	3 (3)
Gastrojejunostomy stricture	3 (4)	3 (4)	1 (2)	5 (5)
Gastrointestinal bleeding	3 (4)	3 (4)	1 (2)	4 (4)
Pulmonary embolism	3 (4)	2 (3)	2 (4)	1 (1)
Small bowel obstruction	3 (4)	2 (3)	0	2 (2)
Gastrogastric fistula	2 (2)	2 (3)	1 (2)	2 (2)
Jejunojunostomy stricture	2 (2)	2 (3)	0	2 (2)
Bile leak	1 (1)	0	0	1 (1)

Similarly, the operative times for LRYGB decreased from 202 min (range, 105–450 min) in group 1 to 134 min (range, 50–91 min) in group 2 ($p < 0.001$). There was a significant correlation between the increasing number of procedures and the decrease in operative times for the patients undergoing LRYGB in group 2 ($p < 0.001$; $r^2 = 0.17$; 95% CI, -0.77 to -0.26), but not in group 1 (Fig. 3).

Postoperative complications

Table 3 summarizes the incidences of postoperative complications in groups 1 and 2. A total of 49 complications occurred for 37 patients (25%) in group 1: 30 for 23 patients (28%) who underwent ORYGB and 19 for 14 patients (20%) who underwent LRYGB.

In group 2, a total of 35 complications occurred for 26 patients (18%): 12 for 11 patients (20%) who underwent ORYGB and 23 for 15 patients (16%) who underwent LRYGB. The difference in complication rates was not significant between the two groups or between the two different surgical approaches (open vs laparoscopic) within the same group.

Five patients (3%) experienced anastomotic leaks in group 1: 2 leaks (2.5%) in patients who underwent ORYGB and 3 leaks (4%) in patients who underwent LRYGB. Four patients (3%) in group 2 experienced anastomotic leaks: 1 leak (1.8%) in a patient who underwent ORYGB and 3 leaks (3%) in patients who underwent LRYGB. There was no statistical difference in the rates of anastomotic leaks between groups 1 and 2, or between patients who underwent either ORYGB or LRYGB within the same group.

Two patients died in group 1 (1.3%). The one patient experienced multiorgan system failure secondary to sepsis from a jejunojunostomy leak, and the other patient underwent ORYGB and died at home on postoperative day 5, presumably of a pulmonary embolism. One patient (0.7%) who underwent ORYGB in group 2 died on postoperative day 5. Postmortem examination documented a massive pulmonary embolus. There was no difference in mortality rates between groups 1 and 2.

Discussion

Roux-en-Y gastric bypass is considered one of the most technically challenging laparoscopic procedures. Rela-

tively short rotations during general surgery residency do not provide exposure to a sufficient number of cases for surgeons-in-training to overcome the long learning curve for RYGB and to master the complex nature of bariatric medicine. Therefore, further training focused on bariatric surgery is necessary to bridge that gap in trainee knowledge. Consequently, establishment of bariatric surgery fellowship training programs has become a common occurrence both in university- and community-based practices.

Although the benefit for trainees is clear, it is uncertain whether training a fellow in highly complex laparoscopic procedures will have any impact on the operative outcomes previously achieved by experienced attending surgeons. We therefore compared the outcomes for patients undergoing bariatric surgery before and after the establishment of the fellowship training program at our institution. We believe that establishing a fellowship program has had a positive impact on our practice because it has allowed us to approach a greater percentage of patients laparoscopically and to undertake more difficult cases (patients with higher BMI values and a higher incidence of previous abdominal procedures) while decreasing operative times and conversion rates.

The learning curve often is defined as the number of procedures an average-skilled surgeon must undertake to become proficient in a particular procedure. Long learning curves have been associated with adverse clinical outcomes [10]. Operative outcomes including operative times, conversion rates, lengths of hospital stay, and complication rates are reported to decrease significantly after 50 laparoscopic antireflux procedures [3, 19]. Similar results are described for most laparoscopic procedures including splenectomy [14], inguinal hernia repair [15], ventral hernia repair [2], and radical prostatectomy [6]. In a recently published study of patients undergoing LRYGB, the early learning curve is associated with longer operative times, a higher incidence of complications, higher reoperation rates, and a longer hospital stay [10].

Most experts agree that the learning curve for laparoscopic procedures is longer than for open surgery. Additionally, the transfer of knowledge based on open surgical experience to newly introduced laparoscopic skills does not occur readily, underscoring the need for intensive training [18]. It has been our impression that

weekend training courses and weekend animal laboratory sessions do not translate into reproducible technical skills for performing complex laparoscopic procedures such as LRYGB. Surgeons therefore require time out of their practices to undergo adequate training and to master complex laparoscopic procedures. Additionally, we believe that the difficulty in acquiring the advanced laparoscopic skills necessary for safe performance of LRYGB remains the major obstacle for its widespread adoption. Alternatively, structured fellowship training allows for a gradual and supervised transfer of knowledge and surgical experience from experienced surgeons to the technical novice, thereby shortening the learning curve for the latter.

Staple-line leaks after LRYGB are perceived to be similar to bile duct injuries after laparoscopic cholecystectomy and esophageal perforations after laparoscopic Nissen fundoplication as an indicator of a surgeon's inexperience. A higher rate of specific operative complications was observed while surgeons were learning the laparoscopic technique for cholecystectomy and Nissen fundoplication. As experience accumulated, bile duct injuries during cholecystectomy and esophageal perforations during Nissen fundoplication decreased after the first 50 procedures [4, 17]. Nevertheless, some of these scenarios occurred when surgeons were pioneering these procedures without formal training. Similar trends have been observed in relation to LYRGB, with apparent variability in care and outcomes.

The argument that attending physicians have better outcomes than trainees has been proven false when trainees are well supervised during minor and major open gastrointestinal surgical procedures [13, 15]. Primary inguinal hernia repairs undertaken by supervised senior surgery residents have outcomes similar to those of attending physicians [15]. Moreover, elective laparoscopic cholecystectomy for symptomatic cholelithiasis by trainees under direct supervision is not associated with an increase in operative time, conversion rates, incidence of complications, or length of hospitalization, as compared with those for experienced laparoscopic surgeons [7]. On the basis of our data, we believe this to be true also in bariatric surgery, given that the attending physician has overcome the learning curve for LRYGB and has standardized patient selection, equipment and instruments, operative technique, postoperative care, and staff education before establishment of a bariatric surgery fellowship training program.

At our institution, senior residents rotate in the bariatric surgery service every 6 to 8 weeks. Without prior operating exposure to advanced laparoscopic surgery, residents' involvement in the LRYGB was limited to performing the cholecystectomy as the surgeon, and serving as the first assistant during the remainder of the procedure. These limitations were reflected in the operative times for LRYGB in group 1 because they indicated resident-attending team experience. As expected, compounding the attending physician's experience by the growing experience of a fellow significantly shortened the operative times for LRYGB in group 2. Additionally, we demonstrate an association between the increasing number of procedures (as a surrogate of

fellow-attending experience) and reduced operative times for both open and laparoscopic RYGB.

During a surgeon's early experience, it is common to limit LRYGB to relatively easier cases by excluding extremely obese patients, patients with central obesity, and patients with previous abdominal procedures [5]. Operative times, complication rates, and lengths of hospital stay have been reported to decrease once a surgeon is beyond the learning curve for LRYGB [5, 8]. Kligman et al. [8] reported no significant increase in age or BMI during their learning curve for their first 160 consecutive patients undergoing LRYGB.

Conversely, we observed a significant increase in BMI for patients undergoing surgery after the establishment of the fellowship training program because the compounded experience of the attending surgeon and the fellow allowed us gradually to increase our weight limitation for LRYGB candidates. Additionally, we were able to undertake LRYGB for a greater number of patients with previous abdominal procedures. The relationship between outcomes for the technically demanding subgroup of patients with a higher BMI and previous abdominal procedures also was described by Schauer et al. [16], who reported shorter operative times and lower complication rates after the first 100 patients.

Although it evaluated only two surgeons, a recent study suggested that undergoing fellowship training in laparoscopic bariatric surgery improves outcomes during early experience with LRYGB [12]. According to Kothari et al. [9], fellowships in advanced laparoscopy with an emphasis on LRYGB provide the optimal training environment for the acquisition of skills necessary to perform bariatric operations safely and effectively. Moreover, fellowship training in LRYGB substantially shortens operative times during a surgeon's initial clinical experience in a hospital with an established bariatric surgery program [1].

Conclusion

Fellowship training programs are excellent tools for the training of future bariatric surgeons. The benefits of training fellows transcends the face value of added manpower by increasing efficiency, as reflected by shortened operative times and by the laparoscopic treatment of more technically challenging patients without an increase in complications. We believe that establishing a fellowship program has had a positive impact on outcomes, and has allowed us to expand the scope of our bariatric practice.

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