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CLINICAL RESEARCH

Fast-Track Laparoscopic Gastric Bypass Surgery: Outcomes and Lessons from a Bariatric Surgery Service in the United Kingdom

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Abstract
Background Laparoscopic Roux-en-Y gastric bypass (LRYGB) is a potentially complicated surgery with significant hospitalisation, especially during the learning curve. There are inadequate data on fast-track LRYGB in relation to learning curve. This study highlights the outcomes of a fast-track LRYGB service.
Methods This observational study examined the perioperative outcome data of 406 consecutive LRYGB patients over a 4-year period. Perioperative outcome data were analysed and compared between severe obesity, morbid obesity and super obesity groups.
Results Mean BMI was 48.6±8.3, mean age was 42 years and male to female ratio was 1:4. About 4% of patients had concurrent ventral hernia repair. Median duration of combined LRYGB and ventral hernia repair was 115 min, compared to 95 min for LRYGB alone (p=0.09). Intraoperative complication rate was 0.5%. Postoperative complications occurred in 3.4% of patients with 60% within 24 h. The complication rate per obesity group was <7% and similar between groups (p=0.4). There was no perioperative mortality. More super obese patients received postoperative intensive care compared to others (p=0.001). Mean length of hospital stay was similar between obesity groups and decreased from 2 to 1 day over 2 years. There was a learning curve of 109 cases over 2 years.
Conclusion LRYGB is a safe technique of bariatric surgery with low risk of perioperative complications. Establishing a fast-track LRYGB service requires a learning curve of 100 cases, and a good indicator is length of hospital stay, which decreases as the service matures. Most LRYGB patients can be safely discharged by 24 h.

Keywords Bariatric surgery · Laparoscopic gastric bypass · Fast track · Learning curve · Perioperative outcomes · Enhanced recovery

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Introduction

Bariatric surgery has become an established therapy for the management of patients with morbid or complicated obesity. Laparoscopic Roux-en-Y gastric bypass (LRYGB) is a popular and effective bariatric surgery approach [1, 2]. The expanding popularity of LRYGB for surgical therapy of morbid obesity has increased the awareness of the peculiar challenges that bariatric patients pose to anaesthesiologists and surgeons. Pre-existing comorbidities, difficult airway management, physiologic responses to laparoscopic pneumoperitoneum, surgical complications, postoperative pain and medical complications are some perioperative factors that impact on the outcome or recovery of LRYGB patients [3–5].

LRYGB is a potentially long and complicated surgery, with possible significant length of hospital stay especially during the learning curve period of the bariatric perioperative team [6]. There is inadequate contemporary information on fast-track LRYGB, in relation to the maturity, development or learning curve of a bariatric surgery service. Published patient outcome data are the crown jewel of bariatric surgical care, but there is a dearth of published LRYGB outcome data from the United Kingdom. This study reviews the learning experience and outcomes of a fast-track LRYGB bariatric service in the UK.

Patients and Methods

The study was registered and approved by the research department of Central Manchester University Hospital, Manchester, UK. Retrospective outcome data were collected for the period of January 2005 to December 2006; and prospective data were recorded for the period of January 2007 to December 2008. All the patients underwent laparoscopic Roux-en-Y gastric bypass in our bariatric surgery service: at our university hospital and an affiliated independent hospital. The goal of our service was to provide fast-track perioperative care to all patients, with appropriate short hospital stay. Perioperative care was provided over the 4-year period of the study by the same clinical team of one surgeon and three anesthesiologists.

Data collected included age, gender, body mass index (BMI), pre-existing comorbidities, American Society of Anesthesiologists (ASA) physical status score, diagnosis of obstructive sleep apnoea (OSA), anaesthesia technique or agent, laryngoscopy grade, surgery duration, perioperative monitoring, perioperative complications, intensive care unit duration, length of hospital stay and mortality. BMI was categorized as: severe obesity (36–39.9), morbid obesity (40–49.9) and super obesity (≥50).

Data were analysed using SPSS version 17 (SPSS Inc, Chicago, IL, USA) and included descriptive statistics. Bivariate analysis was performed using the Student's *t* test. Differences between groups were compared using the Pearson chi-square test or the Fisher's exact test as appropriate. *p* value <0.05 was considered statistically significant.

A total of 406 consecutive LRYGB patients were studied over the 4-year period. The BMI and gender distribution is shown in Table 1 with a BMI range of 36–81, mean of 48.6 (±8.3), median of 47 and male to female ratio of 1:4.

All the patients were adults. The age range was 17–70 years, mean age was 42 (±10) years and median age was 42 years. The age distribution is shown in Table 2.

Results

Approximately 23% of the patients had preoperative clinical features of OSA, especially snoring and daytime somnolence. Of these suspected cases of OSA, 40% (9% of total) underwent preoperative sleep oximetry or polysomnography and 15% (3.5% of total) used mask continuous positive airway pressure (CPAP) during sleep at home.

Table 1 BMI and gender distribution, count (percentage of total)

	Male	Female	Total
Severely obese	5 (1.2%)	36 (8.9%)	41 (8.9%)
Morbidly obese	30 (7.4%)	170 (41.9%)	200 (49.3%)
Super obese	38 (9.4%)	127 (31.2%)	165 (40.6%)
Total	73 (18%)	333 (82%)	406 (100%)

The preoperative ASA physical status classification for the 406 patients is shown in Table 3. The significant majority of morbidly obese patients were ASA 2, while the super obese were mostly ASA 3.

Approximately 4% of patients had significant ventral abdominal hernia that was repaired simultaneously during laparoscopic bariatric surgery, with 75% of these cases occurring in the latter 2 years of the study. About 63% of the combined ventral hernia repair and bariatric procedures were completed in 2 h, 37% required 3 h of operating time, mean duration was 140 min and median duration was 115 min. The mean and median durations for bariatric procedures without ventral hernia repair were relatively shorter at 100 and 95 min, respectively. However, the difference in duration was not significant ($p=0.09$).

Intraoperative monitoring of direct arterial blood pressure was required in only three patients (0.7%) who were super obese. More than 80% of patients in all groups were placed in the ramp position before anaesthesia induction and tracheal intubation. The grade of direct laryngoscopy is shown in Table 4. There was no case of grade 4 laryngoscopy and no difference between the groups ($p=0.6$). The neuromuscular blocking drug used to facilitate laryngoscopy and tracheal intubation was rocuronium in 67% of cases, atracurium in 30% and succinylcholine in 3%. Anaesthesia was maintained with inhalational agents in 95% of cases and total intravenous anaesthesia in 5%. The overall intraoperative complication rate was 0.5%, occurring in two super obese patients, in the form of aspiration pneumonia and atrial fibrillation. These complications also had a limited and brief postoperative phase. There was no perioperative mortality.

About 21% of patients received elective postoperative intensive care, and 27% of these (5.7% of total) had preoperative OSA. Approximately 5% of severe obesity, 10.5% of morbidly obese and 38% of super obese patients required elective postoperative intensive care compared to others ($p=0.001$). A higher proportion of super obese patients received intensive care compared to the other patient groups ($p=0.001$).

Postoperative complications occurred in 3.4% of patients, with 2% occurring at 24 h and 1.4% occurring at 48 h. Complications occurred in 14 patients, within 24 h in four patients each in the morbid and super obesity groups and within 48 h in two patients in each of the three groups. The complications occurred before discharge, and there was no 30-day readmission. Seven patients had dual medical and surgical complications. All patients with postoperative complications had an uneventful initial intraoperative

Table 2 Age distribution, count (percentage of total)

Age group (years)	17–20	21–30	31–40	41–50	51–60	61–70	Total
Count	5	52	134	131	66	18	406
% of total	1.2	12.8	33	32.3	16.3	4.4	100

course lasting <2 h. The complications occurred in the latter 2 years of the study, and there was no recorded complication in the initial 2 years. The complication rate per obesity group was <7% and not significantly different between the groups (p=0.4). The postoperative complications are shown in Table 5.

The average length of stay (LOS) in the hospital was not different between the obesity groups and decreased from 2 to 1 day over 2 years as shown in Table 6. Our performance data, learning curve, LOS for complicated cases and rate of postoperative intensive care (≤1 day) are also shown in Table 6.

Discussion

Laparoscopic Roux-en-Y gastric bypass is usually indicated for the treatment of morbidly obese patients with BMI >40. However, 9% of our patients had BMI of 36–39, but they also had complicated diabetes mellitus and/or hypertension as the co-indications for bariatric surgery. Obesity-related comorbidities especially diabetes mellitus, hypertension and respiratory dysfunction are recognized co-indications for LRYGB [5]. These co-indications will continue to play a greater role in increasing the demand and indication for LRYGB in obese patients, especially as bariatric surgery becomes more popular and affordable.

Standard anaesthesia care was employed for almost all the patients, including non-invasive blood pressure measurement, inhalational anaesthesia maintenance and use of non-depolarising neuromuscular blockers plus high-dose opioids to facilitate tracheal intubation. There was no difference in anaesthetic management between the obesity groups and the intraoperative complication rate was very low, corroborating a previous study [7]. There was no difference in laryngoscopy grades between the obesity groups as shown in a previous study [8]. Direct laryngoscopy was difficult, but successful, in 4% of patients. This good outcome was aided by placing the patients in the ramp position before induction and intubation [9].

The reported mean duration of LRYGB in medical literature is 200 min [6, 10]. The shorter mean duration of 100 min in our study was influenced mainly by the increased operative efficiency in the latter 2 years after our learning curve of 109 cases in the initial 2 years. Although combined LRYGB and ventral hernia surgery had a longer mean duration, the increased duration was not significant. This confirms that the combined procedure is feasible and safe as previously suggested [11]. Also, three quarters of these combined procedures occurred after the learning curve period of 2 years. These outcomes highlight the importance of learning experience and maturity in the development of an efficient, fast-track bariatric surgery service.

Length of stay in hospital for LRYGB perioperative care is usually 2–3 days [1, 6, 12, 13]. The mean LOS in our series decreased from 2 to 1 day over 2 years, mainly because of sustained improvement in perioperative care in the latter 2 years, after our learning curve period. This further highlights the positive impact of the learning curve in improving LOS as a bariatric team matures as a fast-track service. Our study indicates a learning curve requirement of approximately 100 cases towards maturity as a fast-track LRYGB service. A previous study also suggested 100 cases as the learning curve [13]. Another factor that possibly contributed to reduced LOS is the postoperative use of intravenous morphine patient-controlled analgesia, which patients increasingly accepted and were encouraged to use over the years. However, the postoperative analgesia data are inadequate for analysis. Overall, it appears that the main drivers of reduced LOS were our perioperative team's goal to provide fast-track care to all patients and the sustained improvement of our team's skills over the years.

Length of stay in hospital for LRYGB may be prolonged in complicated cases [4, 14]. Postoperative intestinal bleeding, pulmonary embolism and intestinal leak are

Table 3 ASA score and obesity, percentage of total

	ASA 2	ASA 3	ASA 4
Severely obese	8.4%	1.7%	0
Morbidly obese	29.3%	18.7%	1.3%
Super obese	12.3%	26.3%	2%

Table 4 Laryngoscopy grade per obesity group

	Grade 1	Grade 2	Grade 3	Grade 4
Severely obese	83%	12%	5%	0
Morbidly obese	85%	11%	3%	0
Super obese	79%	16%	5%	0
All patients	83%	13%	4%	0

Table 5 Postoperative complications, expressed as count (percentage of total)

	Surgical complications	Medical complications	Rate per BMI group
Severely obese	1 (0.24%)	2 (0.49%)	5%
Morbidly obese	3 (0.74%)	5 (1.23%)	4%
Super obese	3 (0.74%)	7 (1.72%)	6%
Total	7 (1.72%)	14 (3.44%)	p=0.4
NB	These 7 cases also had a medical complication	7 of these cases had a surgical complication	
Specific types of postoperative complications	Intestinal leak and re-op laparoscopy, 2 (0.49%)	Hypopnoea/atelectasis, 9 (2.22%)	
	Intestinal haematoma and re-op laparoscopy, 2 (0.49%)	Limb neuropraxia, 2 (0.49%)	
	Intestinal haemorrhage and transfusion, 1 (0.24%)	Pneumonia, 1 (0.24%)	
	Peritonitis and conservative management, 1 (0.24%)	Atrial fibrillation, 1 (0.24%)	
	Abdominal port bleed and transfusion, 1 (0.24%)	Acute renal failure, 1 (0.24%)	

major complications that may prolong LOS to 11 days [4, 15, 16]. The postoperative complication rate in our series was very low and occurred mostly within 24 h, which confirms that LRYGB may be undertaken as a short-stay procedure, and patients may be safely discharged by 24 h. Other outcome studies have also reported very low rates of perioperative complications [4, 16, 17]. Our study did not find any significant impact of surgical duration or obesity severity on the rate of complications. The fact that postoperative complications occurred only in the latter 2 years of the study could be related to the increased caseload, increasing BMI of the patients or more accurate prospective data recording in the subsequent period after our learning curve.

Our study did not show an association between gender and complications, in contrast to a previous study that reported male LRYGB patients to be heavier, with higher risk of perioperative morbidity [17]. There were five elderly patients, and only one of them had a perioperative complication in the form of transient atelectasis. Overall, the elderly patients had relatively good outcome with no mortality. This suggests that LRYGB is safe in elderly patients as indicated in a previous publication [15].

Appropriate management of postoperative complications is crucial. Laparoscopic management of surgical complications provides excellent outcomes [4, 18]. The cases of intestinal leak and haematoma in our series were promptly managed with uneventful laparoscopy and successful laparoscopic repair and/or haemostasis. The patients who developed postoperative hypopnoea and/or atelectasis did not require postoperative CPAP but made good recovery following aggressive respiratory therapy, including incentive spirometry, humidified oxygen and mobility. They did not have preoperative diagnosis of OSA nor history of CPAP use during sleep. A minority of our patients had OSA, but rarely required postoperative CPAP or intensive care, which corroborates previous reports [19, 20]. However, super obesity is significantly associated with postoperative intensive care as shown in our study and other studies [14, 17].

The few patients who had surgical complications invariably developed a medical complication especially atelectasis. This highlights the gravity of surgical complications following LRYGB. Surgical complications following abdominal surgery are associated with the risk of inflammatory response and secondary respiratory complications especially in obese patients [21–23]. Despite the relatively short operating time, perioperative neuropraxia occurred in two patients. This is surprising because neuropraxia is a rare complication in morbidly obese patients that is related to prolonged immobility and significant pressure on peripheral nerves by the obese anatomy [21].

Table 6 Length of stay in the hospital (days) and learning curve

	Case/week	Mean LOS	LOS 1 day	LOS 2 days	LOS 3 days	LOS 4 days	LOS ≥5 days	ICU 1 day
Year 2005	1	2.1±0.5	5%	72%	15%	3%	5%	20%
Year 2006	1–2	1.5±0.5	53%	33%	7%	3%	4%	33%
Year 2007	3	1.5±0.3	61%	34%	3%	1%	1%	20%
Year 2008	3	1.1±0.3	65%	32%	2%	0.5%	0.5%	17%
Intestinal leak		6.1±1.5						
Intestinal bleed		4.2±1						
Atelectasis		3.2±1						

Conclusion

Laparoscopic Roux-en-Y gastric bypass is a safe technique of bariatric surgery for adult and elderly obese patients. Perioperative complications are uncommon. The establishment of a fast-track LRYGB service requires a learning curve of approximately 100 cases. The indicators of the learning curve include surgical duration and perioperative hospital stay, which tend to improve as the service matures. Many LRYGB patients can be discharged home within 24 h, with very low risk of postoperative complications. Patient selection, surgeon's experience and anaesthesiologist's expertise are key to success. Perioperative outcomes and patient management should be audited periodically to improve patient care and sustain effectiveness. There is a need to establish a multicentre, collaborative database of bariatric outcomes in the UK to share experience.

Conflict of interest disclosure The authors declare that they have no conflict of interest.

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