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ERAS reduces postoperative hospital stay and complications after bariatric surgery

A retrospective cohort study

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Abstract

Enhanced recovery after surgery (ERAS) is a multimodal, multidisciplinary approach for caring surgical patients. The present study aimed to compare the perioperative outcomes of laparoscopic bariatric surgery between patients with ERAS and those with conventional care.

The clinical data of all patients undergoing primary laparoscopic bariatric surgery between January 2014 and June 2017 were retrospectively collected and reviewed. Patients were managed with conventional care during 2014 to 2015 (conventional care group) and with ERAS protocols during 2016 to 2017 (ERAS group). The 2 groups were compared in terms of postoperative length of hospital stay (LOS) and postoperative day 1 discharge rate.

A total of 435 consecutive patients were included with 198 patients in the conventional care group and 237 patients in the ERAS group. The ERAS group had significantly shorter LOS (2.2 ± 0.9 vs 4.0 ± 2.6 days, $P < .01$) and significantly higher day 1 discharge rate (15.2% vs 1%, $P < .01$) compared with the conventional care group. During postoperative 30 days, the ERAS group had significantly less complications (2.1% vs 8.6%, $P < .01$) and readmissions (1.3% vs 4.5%, $P = .02$) compared with the conventional care group.

Compared with conventional care, ERAS significantly reduces postoperative LOS, complications, and readmissions in patients undergoing laparoscopic bariatric surgery.

Abbreviations: ERAS = enhanced recovery after surgery, LOS = length of hospital stay, RYGB = Roux-en-Y gastric bypass, SG = sleeve gastrectomy.

Keywords: bariatric surgery, enhanced recovery after surgery, length of stay, patient discharge, patient readmission

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1. Introduction

Obesity is a worldwide epidemic disease with an ever-growing prevalence, leading to a significant increase in morbidity and mortality.[1] Patients with obesity are at increased risks of type 2 diabetes, cardiovascular diseases, hypertension, hyperlipidemia, cancer, arthritis, and obstructive sleep apnea syndrome.[1] Morbid obesity also significantly affects the quality of life and decreases life expectancy.[1]

Bariatric surgery is believed to be superior to medical therapy for morbid obesity for greater weight loss and the greater remission of diabetes and other obesity-related disorders.[2] It is also the most effective treatment for severe obesity and diabetes.[3,4] Roux-en-Y gastric bypass (RYGB) and sleeve gastrectomy (SG) are the 2 most popular bariatric procedures. As the gold standard of bariatric surgery, RYGB combines a restrictive effect of the stomach and complex metabolic response, which leads to reduced food intake and sustained potent glucose control.[5,6] In recent years, SG is becoming increasingly popular for its technical simplicity. SG is comparable to gastric bypass in weight loss and glucose control, both through similar mechanisms of stomach restriction and hormonal response.[7]

Enhanced recovery after surgery (ERAS) is a multifaceted approach to perioperative care of surgical patients. The benefits of enhanced recovery pathways were first shown in colorectal carcinoma surgery.[8] Since then, ERAS protocols (also known as fast-track protocols) have been adapted for different types of abdominal procedures aiming to reduce morbidity and

mortality.[9,10] The ERAS society published recommendations for bariatric surgery in 2016.[11] By incorporating evidence-based modifications of pre-, intra-, and postoperative modalities, ERAS programs standardize and optimize perioperative care to reduce stress response and thereby enhance patient recovery.[12]

There has been increasing interest in applying enhanced recovery in bariatric surgery. Some recent meta-analyses concluded that ERAS in bariatric surgery reduced hospital stay without worsening overall morbidity.[13–15] Two randomized clinical trials of ERAS programs versus conventional care in RYGB and SG showed that ERAS was associated with shortened length of hospital stay (LOS) and was cost-effective without increasing readmission and perioperative morbidity.[16,17] Besides, a series of prospective, observational studies also had similar findings.[18–20]

China has witnessed a rapid increase in the volume of bariatric surgery in the last decade. The high surgical volume has put considerable pressure on medical resources and hospital beds. Therefore, many hospitals are incorporating ERAS in bariatric surgery to shorten postoperative hospital stay. The present study was designed to compare the postoperative LOS and short-term outcomes in bariatric surgery between patients with ERAS and conventional care at a large bariatric surgery center.

2. Methods

2.1. Patients

The clinical data of patients treated at Beijing Friendship Hospital from January 2014 to June 2017 were retrospectively collected. All procedures were performed by a single consultant surgeon (HM). The inclusion criteria were: diagnosed with morbid obesity; received primary bariatric surgery of laparoscopic RYGB or laparoscopic SG. ERAS protocols were introduced in this center in January 2016. Patients treated from January 2014 to December 2015 were managed with conventional care and were included in the conventional care group. Patients treated from January 2016 to June 2017 were managed with ERAS protocols and included in the ERAS group. This study was approved by the Ethics Committee of our hospital (No. BJFH-EC/2014–093).

2.2. Variables

Demographic information, comorbidities, operative data, concomitant procedures, postoperative LOS, 30-day postoperative complications, and 30-day postoperative readmissions were compared between the conventional care group and the ERAS group. LOS was defined as the number of nights spent in the hospital after surgery. Complications were graded according to the Clavien–Dindo classification.[21–23]

2.3. ERAS protocols

The ERAS protocols were introduced into perioperative care by our team in January 2016. A psychiatrist was consulted, if necessary, to prepare the patient's psychological condition for the operation. On the day before surgery, patients and their families received detailed information on the operation and dietary instructions.

Solid food was allowed until preoperative 8 hours and clear fluids until preoperative 4 hours. Anti-embolism stockings were applied at preoperative 2 hours for the prevention of deep venous thrombosis and pulmonary embolism. Instead of urinary catheterization, patients were required to urinate before going to the operating room.

Antibiotics, analgesics, and antiemetics were intravenously administered at preoperative 10 minutes. Throughout the procedure, patients were monitored using a bispectral index monitor, which was applied to the forehead. Pressure-controlled ventilation with a positive end-expiratory pressure at 10 cm H_2O was used. Short-acting and standardized intravenous anesthetics such as propofol, remifentanil, desflurane, and rocuronium for muscle relaxation were used rather than traditional inhalational anesthetics. To prevent postoperative nausea and vomiting, 8 mg dexamethasone was administered intravenously at the beginning of the surgery and ondansetron at the end. All port sites were infiltrated with ropivacaine and lidocaine preperitoneally. Nasogastric tubes and drains were avoided, and a restrictive perioperative fluid regimen ($\leq$25 mL/kg/24 h) was followed.

Early mobilization and a liquid diet were encouraged. Patients were asked to move by themselves from the operating room to the ward after surgery. A liquid diet was initiated 2 hours after surgery. Within postoperative 24 hours, pain control was provided with intravenous flurbiprofen axetil.

As early as postoperative day 1, the time to discharge was discussed with the patients and their families. Discharge was planned after a final medical review and assessment for pain control, tolerance of oral fluid (i.e., 5–10 mL of clear water every 3–5 minutes, approximately 1000 mL per day), and hemodynamic stability. Patients who met all the discharge criteria were discharged on postoperative day 1 (Table 1). Before discharge, patients received instructions on diet, exercises, medications, vitamins, mineral supplements, and proton pump inhibitors.

2.4. Follow-up

Patients were advised to maintain a full liquid diet for 1 week. One week after the operation, a nutrition assistant telephoned the patients to monitor their recovery. Patients were recommended to be followed up at a clinic at 1, 3, and 6 months and 1 year after discharge.

2.5. Statistical analysis

Complication rates are the number of complications divided by the number of patients. Readmission rates are the number of patients who were readmitted divided by the number of patients discharged. All analyses were performed using SPSS Statistics

Table 1

Criteria for discharge on postoperative day 1.

Item	Criteria
Pain	Only mild pain that can be well managed with oral non-opioid analgesics, such as paracetamol
Nausea	No serious nausea or vomiting
Wound	No evidence of wound infection
Mobilization	Can walk >2000 steps per day
Intake	>1 L of liquid daily
Well being	Patient feels confident of daily life after discharge
Fever	Armpit temperature $\leq$37.5 °C
Heart rate	<100 beats/min
Hemoglobin	Postoperative decrease <2 mmol/L
Complication	No postoperative complications

Table 2

Characteristics of patients (n = 436).

	SG with conventional care (n = 177)	SG with ERAS (n = 215)	*P*-value	RYGB with conventional care (n = 21)	RYGB with ERAS (n = 22)	*P*-value
Age, yr*	35.1 ± 10.5	31.9 ± 9.0	<.01	41.9 ± 10.2	39.6 ± 12.4	.50
Age, yr (range)	16–65	14–66		24–62	19–65	
Female, n (%)†	116 (65.5)	166 (77.2)	<.01	12 (57.1)	13 (59)	.90
Body mass index, kg/m^{2*}	39.7 ± 7.1	38.8 ± 6.8	.19	32.3 ± 3.8	34.3 ± 5.1	.14
Body mass index, kg/m^2 (range)	27.1–66.9	27.7–60.5		27.8–40.6	26.4–47.9	
Diabetes mellitus, n (%)†	61 (34.5)	61 (28.4)	.20	21 (100)	21 (95.5)	1.0
Hypertension, n (%)†	62 (35)	78 (36.3)	.77	11 (52.4)	11 (50)	.88
Hyperlipidemia, n (%)†	29 (16.4)	42 (19.5)	.41	8 (38.1)	5 (22.7)	.27
Obstructive sleep apnea syndrome, n (%)†	46 (26)	47 (21.9)	.36	6 (28.6)	6 (27.3)	.92
Gastroesophageal reflux disease, n (%)†	35 (19.8)	27 (12.6)	.05	4 (19)	2 (9.1)	.35
Nonalcoholic fatty liver disease/nonalcoholic steatohepatitis, n (%)†	55 (31.3)	46 (21.4)	.03	4 (19)	6 (27.3)	.52
Polycystic ovarian syndrome, n (%)†	18 (10.2)	28 (13)	.37	2 (9.5)	2 (9.1)	1.0
Smoking, n (%)†	22 (12.4)	24 (11.2)	.71	5 (23.8)	7 (31.8)	.56

Values are presented as means ± standard deviations or numbers (%).

ERAS = enhanced recovery after surgery, RYGB = laparoscopic Roux-en-Y gastric bypass, SG = sleeve gastrectomy.

* Data were analyzed using the independent *t* test.

† Data were analyzed using the Fisher exact test.

22.0 (IBM, New York). Continuous variables are presented as means and standard deviations. Categorical data are presented as frequencies or percentages. Continuous data were compared using the independent *t* test or the Mann–Whitney *U* test depending on the homogeneity of the data. Fisher exact test was used to compare categorical data. A *P*-value <.05 was considered statistical significance.

3. Results

3.1. Patient general information

The final analysis included 435 consecutive patients who underwent primary bariatric surgery with 198 patients in the conventional care group and 237 patients in the ERAS group (Table 2). In patients treated with SG, those managed with ERAS were significantly younger (31.9 ± 9.0 vs 35.1 ± 10.5, $P < .01$) and had significantly more women (77.2% vs 65.5%, $P < 01$) than those managed with conventional care. The proportion of nonalcoholic fatty liver disease/nonalcoholic steatohepatitis did not differ significantly between patients with ERAS care and those with conventional care (21.9% vs 29.8%, $P = .07$). There was no significant difference between patients managed with RYGB/ERAS and those with RYGB/conventional care. SG accounted for 89.4% in the conventional care group, which is close to that in the ERAS group (90.7%).

3.2. Concomitant procedures

A total of 15 (3.4%) patients had concomitant procedures at the time of bariatric surgery (Table 3). There was no significant difference in the number of concomitant procedures between patients managed with conventional care and those managed with ERAS, either they undergo SG (4.0% vs 2.8%, $P = .58$) or RYGB (4.8% vs 4.5% $P = 1.0$).

3.3. Postoperative LOS

The postoperative LOS was significantly shorter in the ERAS group compared with the conventional care group (2.2 ± 0.9 vs 4.0 ± 2.6 days, $P < .01$; Table 4). The postoperative day 1 discharge rate was 15.2% in the ERAS group compared with 1.0% in the conventional care group ($P < .01$). Similarly, significantly more patients in the ERAS group were discharged within postoperative 48 hours than the conventional care group (75.5% vs 25.3%, $P < .01$).

In patients treated with SG, ERAS was associated with significantly shorter LOS compared with conventional care (2.2

Table 3

Concomitant procedures.

	SG with conventional care (n = 177)	SG with ERAS (n = 215)	RYGB with conventional care (n = 21)	RYGB with ERAS (n = 22)
Cholecystectomy, n (%)	5 (2.8)	1 (0.5)	1 (4.8)	0
Appendectomy, n (%)	1 (0.6)	1 (0.5)	0	1 (4.5)
Fenestration of renal cyst, n (%)	1 (0.6)	0	0	0
Ovarian cystectomy, n (%)	0	1 (0.5)	0	0
Hiatus hernia repair, n (%)	0	2 (0.9)	0	0
Abdominal wall hernia repair with mesh, n (%)	0	1 (0.5)	0	0
Total, n (%)	7 (4.0)	6 (2.8)	1 (4.8)	1 (4.5)

Values are presented as numbers (%).

ERAS = enhanced recovery after surgery, RYGB = laparoscopic Roux-en-Y gastric bypass, SG = sleeve gastrectomy.

Table 4

Postoperative length of hospital stay.

	Conventional care (198)	ERAS (n = 237)	*P*-value
Length of hospital stay, d*	4.0 ± 2.6	2.2 ± 0.9	<.01
Length of hospital stay ≤1 day, n (%)†	2 (1.0)	36 (15.2)	<.01
Length of hospital stay ≤2 days, n (%)†	50 (25.3)	179 (75.5)	<.01

Values are presented as means ± standard deviations or numbers (%).
* Data were analyzed using the Mann–Whitney *U* test.
† Data were analyzed using the Fisher exact tests.

± 0.9 vs 3.4 ± 1.4 days, $P < .01$). In patients treated with RYGB, the LOS in the ERAS group was also significantly shorter than the conventional care group (5.6 ± 1.8 vs 8.2 ± 5.1 days, $P < .01$). However, none of the patients treated with RYGB was discharged within postoperative 48 hours due to major (i.e., Clavien–Dindo grades III) postoperative complications.

3.4. Complications and readmissions

A total of 22 complications occurred within postoperative 30 days, including 7 major complications of Clavien–Dindo grade III and 15 minor complications of Clavien–Dindo grades I–II (Table 5). The 30-day postoperative total complication rate in the ERAS group was significantly lower than the conventional care group (2.1% vs 8.6%, $P < .01$). No life-threatening complications or death occurred in either group (Clavien–Dindo grades IV–V).

A total of 11 patients were readmitted within postoperative 30 days, including 3 patients for serious nausea, vomiting, and dehydration, 1 patient for inferior mesenteric vein thrombosis, and 7 patients for intraperitoneal abscess, intestinal perforation, intestinal obstruction, or anastomotic leakage. No patient died during the follow-up. The 30-day readmission rate in the ERAS group was significantly lower than the conventional care group (1.3% [2/237] vs 4.5% [9/198], $P = .02$).

4. Discussion

Our study found that introducing ERAS in a large bariatric surgery center in China significantly shortened postoperative hospital stay and reduced postoperative complications and readmissions.

The goals of ERAS include easing physiologic stress and early recovery of body functions of patients.[24] These goals may help to improve perioperative care for bariatric surgery patients. Previous studies found no increase in complications in patients with ERAS care discharged on postoperative day 1.[25,26] Similarly, our study found that ERAS care significantly increased the postoperative day 1 discharge rate without increasing complications and readmissions.

Our study found that ERAS also significantly reduced postoperative complications in bariatric surgery. The most common postoperative complications were nausea and vomiting and consequent dehydration, which are specifically targeted by ERAS-guided antiemetics and fluid management. Moreover, major complications of Clavien–Dindo grade III also dramatically dropped from 3% to 0.4% in our patients after the implementation of ERAS. Most major complications of bariatric surgery that require intensive treatment occurred >48 hours after the primary procedure.[27] These complications were not likely to be prevented by extending the length of stay to 3 nights, as in the non-ERAS group.

Postoperative complications are associated with a significant increase in readmissions.[28,29] One of the most common reasons for readmissions after bariatric surgery is nausea and vomiting. Longer LOS is also a predictor of readmissions. Another study found that patients with prolonged LOS (>3 days) were 2.57 times more likely to be readmitted in comparison with those with LOS ≤3 days.[30] These findings are consistent with our study that patients with ERAS care had a significant reduction in both LOS and readmissions.

There are limitations in our study. The ERAS group was treated in a more recent period and may benefit from better surgical skills and improvements in medical devices and medicines, such as a shift from 5-port to 3-port laparoscopy; adoption of a liver suspension technique for a larger field of view; and an enhanced suture technique in the SG procedures to deduce bleeding and gastric content leakage. This could contribute to the differences in LOS and complications between the ERAS group and the conventional care group. Besides, with their experience increasing, the surgical team may be more confident than before to discharge patients in an earlier postoperative stage. In addition, the ERAS group was significantly younger, partly

Table 5

Number of postoperative 30-day complications.

Clavien–Dindo grade	Complications	Conventional care (n = 198)	ERAS (n = 237)	*P*-value
Minor		11 (5.6%)	4 (1.7%)	.03
I	Dehydration	3	1	
	Abdominal pain	1	1	
	Wound infection	2	0	
	Nausea and vomiting requiring intravenous fluids	4	1	
II	Urinary tract infection	1	0	
	Inferior mesenteric vein thrombosis	0	1	
Major		6 (3%)	1 (0.4%)	.04
III	Abscess	2	0	
	Jejunojejunal anastomotic obstruction	1	1	
	Intestinal perforation	1	0	
	Anastomotic leakage	2	0	
IV–V		0	0	
Total		17 (8.6%)	5 (2.1%)	<.01

Values are presented as numbers (%).
Data were analyzed using the Fisher exact tests.

due to the increased demand of bariatric surgery in younger people. This may also bias the postoperative complication rate and patient discharge.

5. Conclusions

ERAS protocols are safe and effective in scenarios of bariatric surgery. ERAS care in a large bariatric surgery center significantly reduces postoperative stay, complications, and readmissions.

Author contributions

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