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Enhanced recovery after surgery in patients undergoing laparoscopic common bile duct exploration

A retrospective study

Guowei Li, MS*, Junjie Zhang, MS, Jianfeng Cai, MS, Zusheng Yu, MS, Qunfeng Xia, MS, Wei Ding, MS

Summary

Few reports have focused on the use of enhanced recovery after surgery (ERAS) in laparoscopic common bile duct exploration (LCBDE) to promote the postoperative recovery of patients with choledocholithiasis. Therefore, this study aimed to explore the advantages and safety of ERAS in patients who underwent LCBDE. From December 2016 to February 2020, 86 and 84 patients were retrospectively enrolled in the control and ERAS groups, respectively. The perioperative insulin resistance index, perioperative C-reactive protein level, time of postoperative analgesic use, time of postoperative first flatus, time of abdominal drainage tube removal, time of liver function recovery, and postoperative complications were analyzed between the two groups. The insulin resistance index (1, 3, and 5 days postoperatively) and C-reactive protein level (1, 3, 5, and 7 days postoperatively) in the ERAS group were significantly lower than those in the control group (all $P < .05$). In terms of the postoperative rehabilitation efficacy, the time of postoperative activity of the patient, time of postoperative first flatus, time of postoperative analgesic use, time of abdominal drainage tube removal, time of postoperative T-tube closing, and length of postoperative hospital stay in the ERAS group were significantly shorter than those in the control group (all $P < .05$). Additionally, the overall incidence of postoperative complications in the ERAS group had a decreasing trend when compared with that in the control group ($P = .05$). ERAS can reduce the postoperative stress response and postoperative complications of patients undergoing LCBDE, promote rehabilitation and shorten the length of postoperative hospital stay and therefore has good social and economic benefits.

Abbreviations: ASA = American Society of Anesthesiologists, CT = computed tomography,ERAS = enhanced recovery after surgery, LCBDE = laparoscopic common bile duct exploration, MRCP = magnetic resonance cholangiopancreatography, SD = standard deviation.

Keywords: choledocholithiasis, complications, enhanced recovery after surgery, laparoscopic common bile duct exploration, stress response

1. Introduction

Enhanced recovery after surgery (ERAS) uses a series of optimization measures of evidence-based medicine during the perioperative period to reduce the patient's surgical stress response, prompt the patient to recover quickly and shorten the patient's hospital stay.[1,2] Since Kehlet and Wilmore first proposed the concept of fast-track surgery,[1] ERAS has been successfully applied in many surgical fields, such as in gastrointestinal, hepatobiliary, and pancreatic surgery, and ERAS has achieved considerable results. Network tracking management means that the staff of ERAS-related departments, medical community family doctors, and public organizations jointly form a rapid recovery team for patients, use the WeChat network platform to manage patients throughout the day, and implement the most timely and accurate treatment measures for ERAS in each of the patients. Headed by district general hospitals, the medical community can integrate regional medical resources and implement group operations management to form a community of shared service, responsibilities, interests, and management. Furthermore, ERAS can also promote the rational allocation of regional medical resources, the service capabilities of primary care, and the normative order in seeking medical care.

However, few reports have focused on the use of ERAS in laparoscopic common bile duct exploration (LCBDE) to promote the postoperative recovery of patients with choledocholithiasis. In the present study, we retrospectively analyzed 170 patients who underwent LCBDE to explore the advantages and safety of ERAS in the perioperative treatment of patients who underwent LCBDE.

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The datasets generated during and/or analyzed during the current study are available from the corresponding author on reasonable request.

Department of Hepatobiliary and Pancreatic Surgery, The First People's Hospital of Fuyang, Hangzhou 311499, China.

*Correspondence: Guowei Li, Department of Hepatobiliary and Pancreatic Surgery, The First People's Hospital of Fuyang, No. 429, Beihuan Road, Fuchun Street, Hangzhou 311499, China (e-mail: l-g-w@yeah.net).

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2. Materials and Methods

2.1. Study population

The medical data of 170 patients who underwent LCBDE between December 2016 and February 2020 at the Department of Hepatobiliary and Pancreatic Surgery, the First People's Hospital of Fuyang, were retrospectively reviewed. A total of 170 patients were divided into the ERAS group (n=84) (January 2019 to February 2020) and the control group (n=86) (December 2016 to December 2018). All patients completed LCBDE, intraoperative choledochoscopic lithotomy, and T-tube placement. In addition, 100 patients with simultaneous cholecystolithiasis were treated with laparoscopic cholecystectomy. This study was approved by the Ethics Review Committee of the First People's Hospital of Fuyang, with a waiver for individual consent by the committee owing to the retrospective study design. All patients were diagnosed with common bile duct stones with or without gallbladder stones or hepatolithiasis by magnetic resonance cholangiopancreatography (MRCP), B-ultrasound, or computed tomography (CT). The exclusion criteria were as follows: (1) patients with malignant tumors of the hepatobiliary and pancreatic systems; (2) patients with a history of upper-abdomen surgery and severe local adhesions; and (3) patients suffering from uncontrollable hypertension, severe cardiopulmonary diseases or severe diabetes.

2.2. Standard medical procedures

The ERAS group was treated under the optimized network tracking management for ERAS. Before admission, the medical community family doctors and the attending doctor jointly informed the patients of the necessity of the operation and the significance of ERAS. After admission, the attending doctor, primary nurse, and anesthesiologist informed the patient about the operation and the importance of ERAS. A specific WeChat group was established that was composed of the patients and their families, the doctors and nurses from the Department of Anesthesiology, Nutrition and Radiology, the medical community family doctors, and public organization personnel to communicate and deal with problems found in the management process. The attending doctor completed the assessment 1–2 days before the operation and provided the patients with detailed information about the operation plan and ERAS. The primary nurses provided psychological counseling to eliminate the patients' anxiety and to achieve patient cooperation to reduce preoperative stress.

None of the patients had an enema performed or a gastric tube or a urinary catheter placed on the morning of the operation. If necessary, these were placed after successful anesthesia. All patients fasted for 6 hours, were deprived of water for 2 hours and were given 250 ml of 5%–10% glucose before surgery. The indoor temperature of the operating room was controlled, the normal body temperatures of the patients were supported during anesthesia, the operating table was equipped with a heater, warm fluids were infused, and the abdominal cavity was flushed with warm saline. Endotracheal anesthesia combined with epidural anesthesia was adopted, and goal-directed fluid therapy (GDFT) was provided. The abdominal drainage tube was reserved only for patients with excessive intraoperative bleeding, large wounds, or suspected bile leakage. Six hours after the operation, the patients were encouraged to get out of bed and were given a liquid diet. The patient was gradually transferred to a normal diet, and the urinary catheter was removed 1 day after the operation. Postoperative analgesia with remifentanil + bupivacaine was administered by an epidural catheter for three days. The abdominal drainage tube was removed until the volume of drainage fluid was less than 30 mL/day. The T-tube was clamped approximately 7 days after the operation and removed 2 weeks after the operation. According to the requirements of the ERAS, the ward doctors and primary nurses assisted the patients in completing the treatment until discharge and informed the patients and their families of the follow-up plan. After discharge, the family doctors and medical community volunteers continued to assist in the treatment of the patients.

The patients in the control group received routine LCBDE treatment, preoperative information, and surgical nursing care. The perioperative management followed the traditional procedure: 12 hours of preoperative fasting, 6 hours of preoperative water deprivation, traditional bowel preparation before the operation, gastric tube placement on the morning of the operation (this was removed after the recovery of intestinal peristalsis), and the placement of a urinary catheter the morning of the operation. Tracheal intubation plus combined intravenous inhalational anesthesia and traditional intraoperative fluid management were provided to all the patients. An abdominal drainage tube was placed after the operation. The abdominal drainage tube was removed when the volume of drainage fluid was less than 30 mL/day. The T-tube was clamped approximately 7 days after the operation and removed 2 weeks after the operation.

The discharge criteria for all the patients were able to move freely, normal body temperature, absence of pain, no obvious discomfort after eating, flatus and bowel movements, and good healing of surgical sites.

2.3. Outcome measurements

The insulin resistance index, C-reactive protein level, and albumin level were detected before and after surgery. The time of getting out of bed after the operation, frequency of analgesic treatments, analgesic effect, time of the first postoperative flatulence, time of removing the abdominal drainage tube, time of clamping the T-tube, and length of postoperative hospital stay were noted.

2.4. Statistical analysis

The data were analyzed using SPSS software (version 19.0). The mean ± standard deviation (SD) was used for the measurement data, the independent-sample t test was used for comparisons between the groups, and the chi-square test was used for the comparison of count data. Differences were considered to be statistically significant at $P < .05$.

3. Results

There were 44 males and 40 females in the ERAS group, with an average age of 40.2 years. There were 48 males and 38 females in the control group, with an average age of 43.7 years. The patients with simultaneous cholecystolithiasis were diagnosed by pathology as having benign gallbladder disease after the operation.

There were no significant differences in age, sex, American Society of Anesthesiologists (ASA) class, stone classification, weight, Child–Pugh grade or operation time between the two groups (all $P > .05$, Table 1). Patients in both groups were clinically cured and discharged from the hospital without any perioperative deaths.

The insulin resistance index (1, 3, 5 days postoperatively) and the C-reactive protein level (1, 3, 5, 7 days postoperatively) in the ERAS group were significantly lower than those in the control group, while the nutritional status (1, 3, 5 days postoperatively) of patients in the ERAS group recovered better than that in the control group (all $P < .05$, Table 2). The postoperative active time, time of postoperative analgesic use, time of postoperative first flatus, time of abdominal drainage tube removal, time of postoperative T-tube closing, and length of postoperative hospital stay in the ERAS group were significantly shorter than those of the control group (all $P < .05$, Table 3).

Table 1

General conditions between the ERAS group and the control group.

	ERAS group (n=84)	Control group (n=86)	*P* value
Age	40.2 ± 15.9	43.7 ± 14.1	.131
Sex			.653
Male	44	48	
Female	40	38	
Weight (kg)	61.7 ± 18.9	58.9 ± 16.8	.309
ASA class			.546
I	43	48	
II	41	38	
Stones			.524
Only choledocholithiasis	24	31	
Combined with hepatolithiasis	7	8	
Combined with cholecystolithiasis	53	47	
Child-Pugh grade			.362
A	50	57	
B	34	29	
Operation time	129 ± 15.78	136 ± 19.76	.660

ASA = American Society of Anesthesiologists, ERAS = enhanced recovery after surgery.

Table 2

Blood factor values between the ERAS group and control group.

	ERAS group (n=84)	Control group (n=86)	*P* value
Insulin resistance index			
Preoperative	4.3 ± 0.7	4.5 ± 0.8	.085
Postoperation 1 d	5.1 ± 1.3	8.7 ± 1.8	.021
Postoperation 3 d	4.6 ± 0.5	7.4 ± 0.9	.014
Postoperation 5 d	3.9 ± 0.6	4.3 ± 1.2	.008
Postoperation 7 d	3.6 ± 1.2	3.9 ± 1.3	.120
C-reactive protein level (μg/L)			
Preoperative	18 ± 5	18 ± 6	.886
Postoperation 1 d	78 ± 18	102 ± 17	<.001
Postoperation 3 d	42 ± 11	89 ± 15	.002
Postoperation 5 d	38 ± 10	67 ± 11	<.001
Postoperation 7 d	29 ± 8	37 ± 15	.004
Nutritional status (albumin mg/L)			
Preoperative	331.7 ± 42.2	349.2 ± 35.4	.211
Postoperation 1 d	307.8 ± 44.1	287.9 ± 59.8	.022
Postoperation 3 d	316.7 ± 39.8	301.4 ± 51.2	.017
Postoperation 5 d	349.7 ± 54.3	328.9 ± 45.9	.008

ERAS = enhanced recovery after surgery.

The overall incidence of postoperative complications in the ERAS group had a decreasing trend compared with that in the control group (P = .05). However, the incidence of abdominal infection, enteroparalysis, bile leakage, pulmonary infection, incisional hernia, and residual calculi in the two groups was not significantly different (Table 4).

4. Discussion

In our study, we found that the postoperative insulin resistance index and C-reactive protein level in the ERAS group were significantly lower than those in the control group. Furthermore, the time that the patient was active postoperatively, time of postoperative analgesic use, time of postoperative first flatus, time of abdominal drainage tube removal, time of postoperative T-tube closing, and length of postoperative hospital stay in the ERAS group were superior to those in the control group because of the efficiencies related to ERAS and teamwork. Additionally, the overall incidence of postoperative complications in the ERAS group was gradually decreasing when compared with that in the control group. The patients' postoperative nutritional statuses recovered faster in the ERAS group than in the control group. All of these results suggest that the use of ERAS in patients who undergo LCBDE can relieve surgical stress, reduce the incidence of complications and accelerate patient recovery.

Table 3

Status of the postoperative recovery between the ERAS group and the control group.

	ERAS group (n=84)	Control group (n=86)	*P* vlaue
Postoperation active time of the patient			<.010
6–24 h	67	51	
>24 h	17	35	
Analgesic effect			<.010
Good	67	51	
Fair or bad	17	35	
Time of first flatus (h)	27.8 ± 5.67	34.5 ± 8.71	.010
Time of abdominal drainage tube removal (h)	28.5 ± 3.6	32.6 ± 5.8	.020
Time of T-tube closing (h)	135.67 ± 15.64	159.42 ± 19.22	.001
Time of postoperative analgesic use (h)	48.97 ± 10.33	65.34 ± 15.78	.035
Postoperative hospital stay (h)	123.24 ± 9.64	163.24 ± 10.64	.001

ERAS = enhanced recovery after surgery.

Table 4.

Postoperative complications between the ERAS group and the control group

	ERAS group (n=84)	Control group (n=86)	*P* vlaue
Overall complication (%)	7 (8.33%)	16 (18.60%)	.050
Bile leakage (%)	4 (4.76%)	5 (5.81%)	.759
Abdominal infection (%)	0	3 (3.49%)	.084
Pulmonary infection (%)	1 (1.19%)	3 (3.49%)	.323
Incisional hernia (%)	1 (1.19%)	1 (1.16%)	.987
Residual calculi (%)	1 (1.19%)	1 (1.16%)	.987
Enteroparalysis (%)	0	3 (3.49%)	.084

ERAS = enhanced recovery after surgery.

ERAS was first proposed by Kehlet in 2001 and has been successfully applied in several surgical fields, such as cardiothoracic surgery, urology surgery, general surgery, obstetrics and gynecology, and orthopedics.[1–6] The concept of ERAS refers to the application of a variety of methods proven to be effective before, during, and after surgery to reduce surgical stress and complications and accelerate patient recovery after surgery.[7] It includes the following important components: (1) an improved preoperative preparation; (2) more suitable anesthesia, analgesia, and the use of minimally invasive surgery during the operation to reduce surgical stress; and (3) the use of intensive postoperative rehabilitation treatment. ERAS has been applied in many countries, has significantly promoted postoperative rehabilitation, and has improved the prognosis of surgical patients, and its safety and effectiveness have been widely respected and recognized by scholars.[8–13]

Our study was the first to use ERAS in hepatobiliary surgery patients combined with the participation of members of the medical community and public organizations; the combined engagement of patients, clinicians, and members of public organizations has a strong role in the supervision and optimization of the perioperative process of hepatobiliary surgery. Therefore, surgeons can reduce medical mistakes and accidents in the process of managing patients. Combined with the advantages of network tracking management, it can further reduce management omissions and detailed errors, can help complete patient self-renewal and optimization, and improve the patients' medical experience.[14,15] Sufficient communication and management consensus among the network tracking management team played an important role in optimizing our ERAS process. The ERAS process records were available before, during, and after surgery. Detailed records and key assessments were made of each patient's management measures in the perioperative period to avoid omissions and mistakes in ERAS management to the greatest extent.

We should emphasize the important role that high-quality nursing plays in the ERAS process, which improves the accuracy and comprehensiveness of ERAS management. High-quality nursing strengthens preoperative team communication during anesthesia, and for patients' nutritional needs, it can correctly and promptly identify problems and provide the most rigorous and safe surgical management services. Studies have shown that surgery lasting more than 2 hours lowers the patient's body temperature.[16] Hypothermia causes stress in the process of rewarming, thus resulting in adverse effects such as damage to the blood coagulation mechanism and leukocyte function and an increase in cardiovascular burden.[17] In addition, intraoperative and early postoperative heat preservation has been proven to reduce intraoperative bleeding, postoperative infection, and cardiac complications.[18] Therefore, all the patients were kept warm by an air heater during the operation in the ERAS group. Recent evidence shows that controlling the rate of intravenous fluid during and after surgery is helpful to reduce postoperative complications and shorten postoperative hospital stays.[19–21] All patients received goal-directed fluid regimens in the ERAS group. Therefore, anesthesia management in ERAS is quite important. Network tracking management can result in more detailed discussion and effective communication regarding preoperative anesthesia and intraoperative conditions. Effective analgesia can improve the quality of patient recovery and reduce their stress responses.[22] The uniform management of the postoperative analgesic pump ensured the analgesic effect in the patients. Although the pain of some patients is complex and variable, the usage time and dosage of the analgesic pump can be promptly adjusted through the cooperation of the network tracking service team. The anesthesiology department regularly organizes ERAS effect evaluation meetings and learning sessions to discuss the latest guidelines with clinical departments. Every quarter, we summarized the results to improve the management quality and we continuously improved the involvement and collaboration of the various departments.

Our study had several limitations that must be considered. First, given its retrospective design, the current study was subject to possible selection bias as well as diagnostic bias. Second, only 170 patients were included in the study. Third, the present study was conducted at a single institution. Therefore, the performance of multicenter studies with a large sample of patients will strengthen our conclusions.

5. Conclusion

A network tracking management model for ERAS, combined with the participation of the medical community family doctors and public organizations, is promising in accelerating the recovery of patients undergoing laparoscopic common bile duct exploration. ERAS can reduce postoperative complications, shorten hospital stays, decrease treatment costs and improve patient satisfaction.

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Author contributions

GL and JZ collected the data. GL, JC and QX organize and analyzed the data. GL and WD wrote
the manuscript. GL and ZY designed this study.
Data curation: Guowei Li, Jianfeng Cai, Qunfeng Xia
Investigation: Guowei Li, Junjie Zhang, Jianfeng Cai, Zusheng Yu, Qunfeng Xia
Methodology: Guowei Li, Wei Ding
Project administration: Guowei Li
Resources: Guowei Li, Zusheng Yu
Validation: Junjie Zhang
Writing – original draft: Guowei Li, Wei Ding

References

[1] Kehlet H, Wilmore DW. Multimodal strategies to improve surgical outcome. Am J Surg. 2002;183:630–41.
[2] Wilmore DW, Kehlet H. Management of patients in fast track surgery. BMJ. 2001;322:473–6.
[3] Brown JK, Singh K, Dumitru R, et al. The benefits of enhanced recovery after surgery programs and their application in cardiothoracic surgery. Methodist Debakey Cardiovasc J. 2018;14:77–88.
[4] Wang J, Luo Y, Wang Q, et al. Evaluation of the application of laparoscopy in enhanced recovery after surgery (ERAS) for gastric cancer: a Chinese multicenter analysis. Ann Transl Med. 2020;8:543.
[5] Scheib SA, Thomassee M, Kenner JL. Enhanced recovery after surgery in gynecology: a review of the literature. J Minim Invasive Gynecol. 2019;26:327–43.
[6] Christelis N, Wallace S, Sage CE, et al. An enhanced recovery after surgery program for hip and knee arthroplasty. Med J Aust. 2015;202:363–8.
[7] Ljungqvist O, Scott M, Fearon KC. Enhanced recovery after surgery: a review. JAMA Surg. 2017;152:292–8.
[8] Khoury W, Dakwar A, Sivkovits K, Mahajna A. Fast-track rehabilitation accelerates recovery after laparoscopic colorectal surgery. JSLS. 2014;18:e2014.
[9] Esteban F, Cerdan FJ, Garcia-Alonso M, et al. A multicenter comparison of a fast track or conventional postoperative protocol following laparoscopic or open elective surgery for colorectal cancer surgery. Colorectal Dis. 2014;16:134–40.
[10] Goulet D, Danilack V, Matteson KA. Enhanced recovery pathways for improving outcomes after minimally invasive gynecologic oncology surgery. Obstet Gynecol. 2017;129:207.
[11] Yost MT, Jolissaint JS, Fields AC, et al. Enhanced recovery pathways for minimally invasive esophageal surgery. J Laparoendosc Adv Surg Tech A. 2018;28:496–500.
[12] Engelman DT, Ben Ali W, Williams JB, et al. Guidelines for perioperative care in cardiac surgery: enhanced recovery after surgery society recommendations. JAMA Surg. 2019;154:755–66.
[13] Yang R, Tao W, Chen YY, et al. Enhanced recovery after surgery programs versus traditional perioperative care in laparoscopic hepatectomy: a meta-analysis. Int J Surg. 2016;36:274–82.
[14] Agarwal V, Divatia JV. Enhanced recovery after surgery in liver resection: current concepts and controversies. Korean J Anesthesiol. 2019;72:119–29.
[15] Pagano D, Ricotta C, Barbàra M, et al. ERAS Protocol for perioperative care of patients treated with laparoscopic nonanatomic liver resection for hepatocellular carcinoma: the ISMETT experience. J Laparoendosc Adv Surg Tech A. 2020;30:1066–71.
[16] Nesher N, Zisman E, Wolf T, et al. Strict thermoregulation attenuates myocardial injury during coronary artery bypass graft surgery as reflected by reduced levels of cardiac-specific troponin I. Anesth Analg. 2003;96:328–35.
[17] Frank SM, Fleisher LA, Breslow MJ, et al. Perioperative maintenance of normothermia reduces the incidence of morbid cardiac events. A randomized clinical trial. JAMA. 1997;277:1127–34.
[18] Madrid E, Urrútia G, Roqué i Figuls M, et al. Active body surface warming systems for preventing complications caused by inadvertent perioperative hypothermia in adults. Cochrane Database Syst Rev. 2016;4:CD009016.
[19] Brandstrup B. Fluid therapy for the surgical patient. Best Pract Res Clin Anesthesiol. 2006;20:265–83.
[20] Pillai P, McEleavy I, Gaughan M, et al. A double-blind randomized controlled clinical trial to assess the effect of Doppler optimized intraoperative fluid management on outcome following radical cystectomy. J Urol. 2011;186:2201–6.
[21] Benes J, Giglio M, Brienza N, et al. The effects of goal-directed fluid therapy based on dynamic parameters on postsurgical outcome: a meta-analysis of randomized controlled trials. Crit Care. 2014;18:584.
[22] Nimmo SM, Foo ITH, Paterson HM. Enhanced recovery after surgery: pain management. J Surg Oncol. 2017;116:583–91.