

World Journal of *Gastrointestinal Surgery*

World J Gastrointest Surg 2023 October 27; 15(10): 2098-2381



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The primary aim of *World Journal of Gastrointestinal Surgery* (WJGS, *World J Gastrointest Surg*) is to provide scholars and readers from various fields of gastrointestinal surgery with a platform to publish high-quality basic and clinical research articles and communicate their research findings online.

WJGS mainly publishes articles reporting research results and findings obtained in the field of gastrointestinal surgery and covering a wide range of topics including biliary tract surgical procedures, biliopancreatic diversion, colectomy, esophagectomy, esophagostomy, pancreas transplantation, and pancreatectomy, etc.

INDEXING/ABSTRACTING

The WJGS is now abstracted and indexed in Science Citation Index Expanded (SCIE, also known as SciSearch®), Current Contents/Clinical Medicine, Journal Citation Reports/Science Edition, PubMed, PubMed Central, Reference Citation Analysis, China National Knowledge Infrastructure, China Science and Technology Journal Database, and Superstar Journals Database. The 2023 Edition of Journal Citation Reports® cites the 2022 impact factor (IF) for WJGS as 2.0; IF without journal self cites: 1.9; 5-year IF: 2.2; Journal Citation Indicator: 0.52; Ranking: 113 among 212 journals in surgery; Quartile category: Q3; Ranking: 81 among 93 journals in gastroenterology and hepatology; and Quartile category: Q4.

RESPONSIBLE EDITORS FOR THIS ISSUE

Production Editor: Zi-Hang Xu, Production Department Director: Xiang Li, Editorial Office Director: Jia-Ru Fan.

NAME OF JOURNAL

World Journal of Gastrointestinal Surgery

ISSN

ISSN 1948-9366 (online)

LAUNCH DATE

November 30, 2009

FREQUENCY

Monthly

EDITORS-IN-CHIEF

Peter Schemmer

EDITORIAL BOARD MEMBERS

<https://www.wjgnet.com/1948-9366/editorialboard.htm>

PUBLICATION DATE

October 27, 2023

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INSTRUCTIONS TO AUTHORS

<https://www.wjgnet.com/bpg/gerinfo/204>

GUIDELINES FOR ETHICS DOCUMENTS

<https://www.wjgnet.com/bpg/GerInfo/287>

GUIDELINES FOR NON-NATIVE SPEAKERS OF ENGLISH

<https://www.wjgnet.com/bpg/gerinfo/240>

PUBLICATION ETHICS

<https://www.wjgnet.com/bpg/GerInfo/288>

PUBLICATION MISCONDUCT

<https://www.wjgnet.com/bpg/gerinfo/208>

ARTICLE PROCESSING CHARGE

<https://www.wjgnet.com/bpg/gerinfo/242>

STEPS FOR SUBMITTING MANUSCRIPTS

<https://www.wjgnet.com/bpg/GerInfo/239>

ONLINE SUBMISSION

<https://www.f6publishing.com>



Retrospective Study

Optimizing surgical outcomes for elderly gallstone patients with a high body mass index using enhanced recovery after surgery protocol

Yue-Xia Gu, Xin-Yu Wang, Yang Chen, Jun-Xiu Shao, Shen-Xian Ni, Xiu-Mei Zhang, Si-Yu Shao, Yu Zhang, Wen-Jing Hu, Ying-Ying Ma, Meng-Yao Liu, Hua Yu

Specialty type: Nursing

Provenance and peer review:

Unsolicited article; Externally peer reviewed.

Peer-review model: Single blind

Peer-review report's scientific quality classification

Grade A (Excellent): 0

Grade B (Very good): B, B, B

Grade C (Good): C

Grade D (Fair): D, D

Grade E (Poor): E

P-Reviewer: Gad EH, Egypt; Hori T, Japan; Ji ZL, China; Kim BS, South Korea; Kumar M, India

Received: May 27, 2023

Peer-review started: May 27, 2023

First decision: June 14, 2023

Revised: June 23, 2023

Accepted: August 17, 2023

Article in press: August 17, 2023

Published online: October 27, 2023



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Abstract

BACKGROUND

Rehabilitation of elderly patients with a high body mass index (BMI) after cholecystectomy carries risks and requires the adoption of effective perioperative management strategies. The enhanced recovery after surgery (ERAS) protocol is a comprehensive treatment approach that facilitates early patient recovery and reduces postoperative complications.

AIM

To compare the effectiveness of traditional perioperative management methods with the ERAS protocol in elderly patients with gallbladder stones and a high BMI.

METHODS

This retrospective cohort study examined data from 198 elderly patients with a high BMI who underwent cholecystectomy at the Shanghai Fourth People's Hospital from August 2019 to August 2022. Among them, 99 patients were managed using the traditional perioperative care approach (non-ERAS protocol), while the remaining 99 patients were managed using the ERAS protocol. Relevant indicator data were collected for patients preoperatively, intraoperatively, and postoperatively, and surgical outcomes were compared between the two groups.

RESULTS

The comparison results between the two groups of patients in terms of age, sex, BMI, underlying diseases, surgical type, and preoperative hospital stay showed no statistically significant differences. However, the ERAS group had a significantly shorter preoperative fasting time than the non-ERAS group (4.0 ± 0.9 h *vs* 7.6 ± 0.9 h). Regarding intraoperative indicators, there were no significant differences between the two groups of patients. However, in terms of postoperative recovery, the ERAS protocol group exhibited significant advantages over the non-ERAS group, including a shorter hospital stay, lower postoperative pain scores and postoperative hunger scores, and higher satisfaction levels. The readmission rate was lower in the ERAS protocol group than in the non-ERAS group (3.0% *vs* 8.1%), although the difference was not significant. Furthermore, there were significant differences between the two groups in terms of postoperative nausea and vomiting severity, postoperative abdominal distention at 24 h, and daily life ability scores.

CONCLUSION

The findings of this study demonstrate that the ERAS protocol confers significant advantages in postoperative outcomes following cholecystectomy, including reduced readmission rates, decreased postoperative nausea and vomiting, alleviated abdominal distension, and enhanced functional capacity. While the protocol may not exhibit significant improvement in early postoperative symptoms, it does exhibit advantages in long-term postoperative symptoms and recovery. These findings underscore the importance of implementing the ERAS protocol in the postoperative management of cholecystectomy patients, as it contributes to improving patients' recovery and quality of life while reducing health care resource utilization.

Key Words: Enhanced recovery after surgery protocol; Cholecystectomy; Rehospitalization rate; Postoperative nausea and vomiting; Degree of abdominal distension; Daily living ability

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Core Tip: This study compared the effectiveness of the enhanced recovery after surgery (ERAS) protocol with traditional perioperative management methods in elderly patients with gallbladder stones and a high body mass index. The results showed that the ERAS protocol demonstrated significant advantages in postoperative outcomes, including reduced readmission rates, improved postoperative nausea and vomiting, alleviated abdominal distension, and enhanced daily living ability. However, the protocol may not exhibit significant improvement in early postoperative symptoms but demonstrates advantages in long-term symptoms and recovery. Implementing the ERAS protocol in the postoperative management of cholecystectomy patients can contribute to improved recovery and quality of life while reducing health care resource utilization.

Citation: Gu YX, Wang XY, Chen Y, Shao JX, Ni SX, Zhang XM, Shao SY, Zhang Y, Hu WJ, Ma YY, Liu MY, Yu H. Optimizing surgical outcomes for elderly gallstone patients with a high body mass index using enhanced recovery after surgery protocol. *World J Gastrointest Surg* 2023; 15(10): 2191-2200

URL: <https://www.wjgnet.com/1948-9366/full/v15/i10/2191.htm>

DOI: <https://dx.doi.org/10.4240/wjgs.v15.i10.2191>

INTRODUCTION

Due to the increasingly ageing population, there are a growing number of patients with a high body mass index (BMI) and gallstones, which are two factors that pose risks for surgical treatment. To mitigate these risks, enhanced recovery after surgery (ERAS) has been widely implemented in clinical practice for gallbladder surgery. The ERAS protocol emphasizes comprehensive perioperative management, including preoperative preparation, intraoperative management, and postoperative recovery, thus aiming to reduce surgical risks, shorten hospital stays, and improve rehabilitation outcomes[1-4]. Although the effectiveness of the ERAS protocol has been demonstrated in young and healthy patients, its application and effectiveness in elderly patients with a high BMI and gallstones warrant further investigation.

Patients with a high BMI have more prominent surgical risks, such as longer surgical duration, larger incisions, greater blood loss, and prolonged postoperative hospital stays[5,6]. Therefore, the implementation of an ERAS protocol to optimize the surgical treatment of elderly patients with gallbladder stones and a high BMI holds significant clinical significance.

Previous studies have demonstrated the widespread utilization and effectiveness of ERAS protocols in the management of gallbladder surgical procedures[7,8]. However, the majority of these investigations have predominantly focused on young and healthy patient populations, and there is a lack of specialized research concerning elderly patients with a high BMI and gallstone pathology[9,10]. In this retrospective analysis, we collected pertinent clinical data from elderly patients with a high BMI who underwent cholecystectomy at the Fourth People's Hospital of Shanghai from

August 2019 to August 2022. By comparing the surgical outcomes between the ERAS protocol group and the conventional non-ERAS protocol group, we aimed to provide a comprehensive understanding of the application of ERAS protocols in the surgical treatment of elderly patients with a high BMI and gallstone pathology.

MATERIALS AND METHODS

Subject selection

This study employed a retrospective research design and included a total of 198 elderly patients with a high BMI who underwent cholecystectomy at the Fourth People's Hospital of Shanghai from August 2019 to August 2022. Among them, 99 patients were managed with the traditional non-ERAS protocol for perioperative care, while the remaining 99 patients were managed with the ERAS protocol. We specifically chose elderly patients with a high BMI because this population carries certain risks related to postoperative recovery and is more sensitive to factors related to perioperative management. This study obtained approval from the institutional ethics committee and adhered to relevant ethical principles and privacy protection measures (No. 2019047). All participating patients provided informed consent and agreed to the use of their data for research analysis.

Inclusion criteria

The inclusion criteria were as follows: (1) Nonurgent patients scheduled for gallbladder removal; (2) age ≥ 65 years, regardless of sex; (3) no contraindications for biliary surgery or general anaesthesia; (4) absence of significant gallbladder enlargement or gallbladder discharge on ultrasound or magnetic resonance imaging; (5) no concomitant choledocholithiasis or other conditions requiring surgical intervention, no acute or chronic gastrointestinal obstruction, and no symptoms of delayed gastric emptying; (6) willingness of the patient to undergo gallbladder removal; (7) absence of significant mental or psychological disorders, hearing impairment, or language barriers, ability to communicate normally during treatment, possessing independent legal capacity, and ability to express oneself clearly; and (8) agreement from the patient to receive ERAS treatment.

Evaluation indicators and scales

Elderly patients with a high BMI typically refer to patients aged 65 years and above with a BMI equal to or greater than 28 kg/m². Baseline comorbidities refer to preexisting or existing chronic conditions such as hypertension and diabetes. The Hunger score is an indicator used to assess the degree of hunger among patients during the perioperative period. It is generally rated on a scale of 0-2, where 0 indicates no hunger at all, 1 indicates mild hunger that is tolerable, and 2 indicates intolerable hunger or hypoglycaemia requiring intravenous fluid therapy[11]. The postoperative nausea and vomiting (PONV) score is a quantification tool used to assess the severity of PONV[12]. It is scored as follows: 0 points indicate no nausea or vomiting; 1 point indicates mild nausea or vomiting, with patients reporting mild nausea [Visual Analogue Scale (VAS) score < 3 cm] or one episode of vomiting or short-duration (less than 10 min) persistent nausea that resolves without antiemetic medication; and 2 points indicate moderate nausea or vomiting, with patients experiencing 1-2 episodes of vomiting or nausea with a VAS score > 3 cm due to endogenous stimuli, requiring one dose of antiemetic medication for relief. The abdominal distension score is an indicator used to assess the sensation of abdominal bloating in patients and is often used in postoperative or other relevant conditions[13,14]. It is typically described using a scoring system ranging from 0-2 to indicate the degree of abdominal distension. A score of 0 points indicates no abdominal distension, 1 point indicates mild abdominal distension that is tolerable, and 2 points indicate intolerable abdominal distension. The Barthel Index is a scale used to assess activities of daily living[15]. The VAS is also a commonly used pain assessment method, and in this study, the VAS was used to evaluate patients' pain levels. The satisfaction score is a method used to assess patients' satisfaction with medical care or treatment processes[16]. It is typically represented using a numerical range to indicate the degree of satisfaction, with 100 points representing the highest level of satisfaction.

Introduction to the ERAS protocol

The ERAS protocol is a comprehensive treatment approach aimed at promoting early recovery and reducing postoperative complications through strategies such as minimally invasive surgery, thorough preoperative preparation, early postoperative nutritional support, and early rehabilitation training. Specifically, the ERAS protocol encompasses various aspects, including preoperative preparation, anaesthesia, surgical techniques, postoperative pain management, and early nutritional support, among others, providing patients with high-quality perioperative care in a multidimensional manner. The specific protocol flow is detailed in [Figure 1](#).

Data collection

We collected relevant data on preoperative, intraoperative, and postoperative indicators of the patients by reviewing their medical records, surgical records, and follow-up records. Preoperative indicators included age, sex, underlying medical conditions, BMI, and preoperative fasting score at 1 h. Intraoperative indicators included surgical duration, incision length, and blood loss. Postoperative indicators included the incidence of complications, length of hospital stay, pain score at 24 h, fasting score at 6 h postoperatively, satisfaction level, readmission rate, degree of nausea and vomiting at 6 and 24 h postoperatively, degree of abdominal distension at 6 and 24 h postoperatively, and daily living ability score at 24 h postoperatively. These indicators reflected the surgical risk and postoperative recovery of the patients.

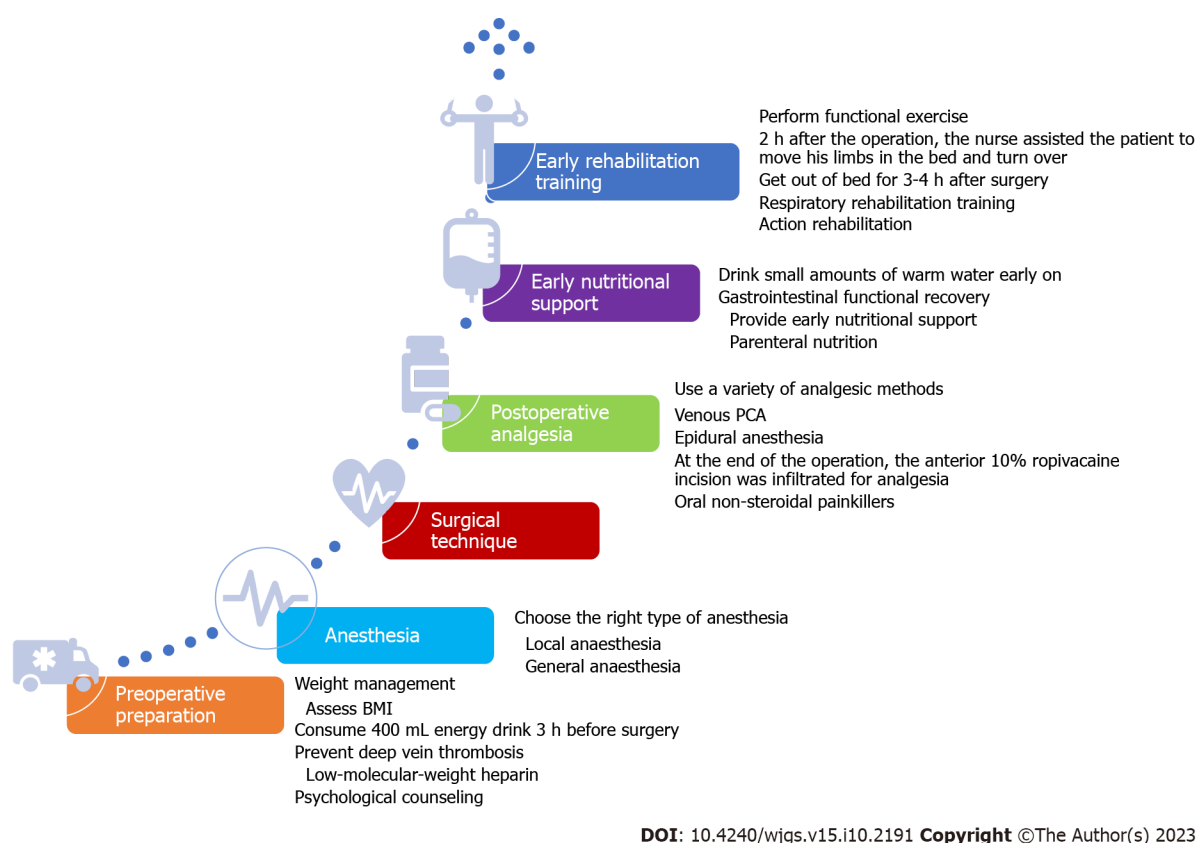


Figure 1 Flowchart of the enhanced recovery after surgery protocol. BMI: Body mass index; PCA: Patient controlled analgesia.

Statistical analysis

Data analyses were performed using SPSS 23.0 software (IBM, 2015, United States). Normality tests were conducted for all continuous variables in this study. Normally distributed variables are reported as the mean \pm SD and were compared using independent sample *t* tests. Nonnormally distributed variables are reported as medians (25th-75th percentile). Categorical data were analysed using Pearson's chi-square test. A *P*-value of < 0.05 was considered statistically significant.

RESULTS

Participant characteristics

A total of 198 elderly patients with a high BMI were included in this study, with 99 patients in the traditional non-ERAS protocol group and another 99 patients in the ERAS protocol group. The basic characteristics of the two groups, including age, sex, BMI, preoperative hunger score, and other variables, are presented in Table 1. There were no significant differences between the two groups in terms of age, sex, BMI, underlying diseases, surgical type, and preoperative hospital stay ($P > 0.05$). However, there was a significant difference in preoperative fasting time between the two groups, with an average fasting time of 4.0 ± 0.9 h in the ERAS group compared to 7.6 ± 0.9 h in the non-ERAS group ($P < 0.001$).

Surgical process and postoperative recovery

The comparison of surgical process variables, including operative time, incision length, blood loss, number of drainage tubes, extubation time, postoperative complications, and pain score at 6 h postoperatively, showed no statistically significant differences between the two groups. However, the ERAS protocol group demonstrated significantly better postoperative recovery than the non-ERAS protocol group. The length of hospital stay (4.62 ± 1.01 vs 5.51 ± 1.15), pain score at 24 h postoperatively (3.43 ± 1.19 vs 4.43 ± 1.21), hunger score, and satisfaction at 6 h postoperatively (98.42 ± 1.13 vs 93.72 ± 2.76) were all significantly better in the ERAS protocol group (Table 2).

Rehospitalization rate and postoperative nausea, vomiting, bloating, and activities of daily living

The aim of this study was to compare the differences in hospital readmission rates and postoperative nausea, vomiting, bloating, and activities of daily living scores between the ERAS group and the non-ERAS group. The results showed that the hospital readmission rate was lower in the ERAS protocol group than in the non-ERAS protocol group (3.0% vs 8.1%, $P > 0.05$), but the difference did not reach statistical significance. Significant differences were observed between the two groups in terms of PONV at 24 h, bloating at 24 h, and activities of daily living scores. However, there was no statistically

Table 1 Comparison of baseline characteristics of study participants

Characteristic	ERAS group (n = 99)	Non-ERAS group (n = 99)	P value
Age (yr), mean \pm SD	69.5 \pm 3.6	69.4 \pm 3.0	0.746
Gender, male, n (%)	49 (49.5)	46 (46.5)	0.670
BMI (kg/m ²), mean \pm SD	29.3 \pm 1.2	29.1 \pm 1.4	0.276
Underlying diseases, n (%)	20 (20.2)	25 (25.3)	0.386
Surgical procedure (laparoscopic/open)	85/14	83/16	0.692
Preoperative hunger score, n (%)			0.052
0	41 (41.4)	25 (25.3)	
1	49 (49.5)	61 (61.6)	
2	9 (9.1)	13 (13.1)	
Preoperative hospitalization time (d)	2.4 \pm 0.9	2.3 \pm 0.8	0.223
Preoperative fasting time (h)	4.0 \pm 0.9	7.6 \pm 0.9	< 0.001

SD: Standard deviation; BMI: Body mass index; ERAS: Enhanced recovery after surgery.

Table 2 Comparison of surgical process indexes and postoperative recovery

Characteristic	ERAS group (n = 99)	Non-ERAS group (n = 99)	P value
Surgical duration (min)	81.27 \pm 23.17	82.97 \pm 24.13	0.614
The incision length (cm)	10.33 \pm 2.84	10.46 \pm 2.81	0.744
Blood loss (mL)	93.52 \pm 28.64	93.68 \pm 24.39	0.966
No. of drainage tubes, n (%)			0.754
0	37 (37.4)	32 (32.3)	
1	30 (30.3)	33 (33.3)	
2	32 (32.3)	34 (34.3)	
Extubation time (h)	39.72 \pm 18.00	40.96 \pm 18.61	0.634
Postoperative complication rate, n (%)	5 (5.1)	10 (13.1)	0.048
Length of hospital stay (d)	4.62 \pm 1.01	5.51 \pm 1.15	< 0.001
Postoperative pain score at 6 h	1.96 \pm 1.11	2.21 \pm 0.82	0.07
Postoperative pain score at 24 h	3.43 \pm 1.19	4.43 \pm 1.21	< 0.001
Postoperative 6-h hunger score			< 0.001
0	45	32	
1	51	35	
2	3	32	
Satisfaction (%)	98.42 \pm 1.13	93.72 \pm 2.76	< 0.001

ERAS: Enhanced recovery after surgery.

significant difference between the two groups in terms of PONV at 6 h and bloating (Table 3). Taking all the results into consideration, the ERAS protocol group demonstrated a significant advantage in terms of rehospitalization rate, with a reduced rehospitalization rate compared to the non-ERAS protocol group. These findings suggest that the ERAS protocol may effectively reduce the rehospitalization rate in patients undergoing cholecystectomy. There may not be significant improvements in early postoperative symptoms, but the protocol may have advantages in terms of long-term symptoms and recovery. These findings emphasize the importance of the ERAS protocol in postcholecystectomy care, as it helps improve patients' recovery and quality of life while reducing health care resource utilization. In addition, rehospitalization rates were not statistically associated with surgical complications or patient comorbidities.

Table 3 Comparison of rehospitalization rate and postoperative scores for nausea and vomiting, abdominal distention, and activities of daily living, *n* (%)

Characteristic	ERAS group (<i>n</i> = 99)	Non-ERAS group (<i>n</i> = 99)	<i>P</i> value
Rehospitalization rate	3 (3.0)	8 (8.1)	0.12
PONV at 6 h			0.322
0	43 (43.4)	49 (49.5)	
1	40 (40.4)	30 (30.3)	
2	16 (16.2)	20 (20.2)	
PONV at 24 h			0.005
0	39 (39.4)	32 (32.3)	
1	50 (50.5)	39 (39.4)	
2	10 (10.1)	28 (28.3)	
Postoperative bloating score at 6 h			0.178
0	40 (40.4)	53 (53.5)	
1	52 (52.5)	41 (41.4)	
2	7 (7.1)	5 (5.1)	
Postoperative bloating score at 24 h			0.006
0	47 (47.5)	34 (34.3)	
1	38 (38.4)	32 (32.3)	
2	14 (14.1)	33 (33.4)	
ADL score	85.75 ± 5.83	83.87 ± 6.72	0.037

RAS: Enhanced recovery after surgery; PONV: Postoperative nausea and vomiting score; ADL: Activities of daily living.

DISCUSSION

In recent years, with the increasing population of elderly individuals and patients with a higher BMI, perioperative management for this specific population has become particularly important[17-19]. The aim of this study was to compare the differences in surgical outcomes between traditional perioperative management methods and the ERAS protocol in elderly patients with a high BMI and gallbladder stones. Through a retrospective study design, we included a total of 199 elderly patients with a high BMI for comparative analysis.

Our research findings indicate that there were no significant differences between the two groups in terms of age, sex, BMI, underlying diseases, surgical type, and preoperative hospital stay, indicating comparability between the two groups at baseline. However, the ERAS protocol group had a significantly shorter preoperative fasting time than the non-ERAS group, which aligns with the characteristic of the ERAS protocol to reduce unnecessary fasting time and alleviate preoperative hunger sensation in patients[20-22].

In terms of intraoperative indicators, there were no significant differences between the two patient groups, indicating that the ERAS protocol did not have a significant impact on the surgical procedure itself. However, in terms of postoperative recovery, the ERAS protocol group showed significant advantages over the non-ERAS protocol group. Patients in the ERAS protocol group exhibited superior outcomes in terms of hospital stay duration, postoperative pain scores, postoperative hunger scores, and satisfaction levels compared to patients in the non-ERAS protocol group. These findings suggest that the ERAS protocol can facilitate early patient recovery, alleviate postoperative pain and hunger, and improve patient satisfaction[10,23-26].

The readmission rate is one of the important indicators for evaluating surgical treatment outcomes. Our study found that the readmission rate in the ERAS protocol group was lower than that in the non-ERAS protocol group. Although there was no significant difference, this result still demonstrates the potential advantage of the ERAS protocol in reducing readmission rates. Additionally, significant differences were observed between the two groups in terms of PONV, bloating, and daily living ability scores. This indicates the clear advantages of the ERAS protocol in reducing postoperative complications and promoting patient recovery[19,27,28].

Although the ERAS group showed a lower readmission rate, the small sample size might lead to a limited ability to observe significant differences in the statistical analysis. Second, while the ERAS group received a series of optimized postoperative care measures, the non-ERAS group might have also received certain effective nursing interventions, resulting in a lack of significant differences in readmission rates. Last, there might be potential confounding factors that influence readmission rates in addition to ERAS interventions, such as patients' underlying diseases, postoperative

rehabilitation support, and adherence to medical instructions. These factors might differ between the two groups, affecting readmission rates without being statistically significant.

Based on the aforementioned results, this study demonstrates significant advantages of implementing the ERAS protocol following cholecystectomy. The application of the ERAS protocol is associated with a reduction in readmission rates, improvement in postoperative nausea, vomiting, and abdominal distention, and enhancement of patients' daily life functionality. While there may not be a significant improvement in early postoperative symptoms, it exhibits advantages in terms of improvement of long-term symptoms and recovery[29-31]. These findings emphasize the importance of the ERAS protocol in postcholecystectomy care, as it contributes to the improvement of patients' rehabilitation and quality of life while reducing the utilization of health care resources[28].

Although this study has yielded some meaningful results, there are still some limitations that need to be acknowledged. First, the study design employed in this research is retrospective, which might have introduced selection bias and information bias. Further prospective randomized controlled trials would provide stronger evidence. Second, this study is limited to the experience of a single medical centre, and the results may not be widely applicable. Multicentre studies with larger sample sizes would better assess the effectiveness of the ERAS protocol in elderly patients with a high BMI and gallstones. Additionally, this study did not include long-term follow-up data, thus limiting the evaluation of the long-term effects and survival rates associated with the ERAS protocol.

In future studies, we recommend incorporating a broader range of clinical indicators and postoperative follow-up data to further evaluate the application of the ERAS protocol in the surgical treatment of elderly patients with gallbladder stones and a high BMI. Additionally, comparative research with other treatment approaches should be considered to further substantiate the advantages and scope of the ERAS protocol.

CONCLUSION

The findings of this study demonstrate that the adoption of the ERAS protocol in elderly patients with a high BMI who are undergoing cholecystectomy provides significant advantages over traditional perioperative management methods. The ERAS protocol is associated with reduced readmission rates, improved PONV symptoms, alleviated abdominal distention, and enhanced functional capacity in these patients. Although there may not be significant improvement in early postoperative symptoms, the ERAS protocol exhibits advantages in terms of long-term postoperative symptoms and recovery. These findings underscore the importance of implementing the ERAS protocol in the postoperative management of cholecystectomy patients, as it contributes to improving patients' recovery and quality of life while reducing health care resource utilization.

ARTICLE HIGHLIGHTS

Research background

The rehabilitation of elderly patients with a high body mass index (BMI) after cholecystectomy poses risks and requires effective perioperative management strategies. The enhanced recovery after surgery (ERAS) protocol is a comprehensive treatment approach that promotes early patient recovery and reduces postoperative complications.

Research motivation

The aim of this study was to compare the effectiveness of traditional perioperative management methods with the ERAS protocol in elderly patients with gallbladder stones and a high BMI.

Research objectives

The study aimed to assess and compare the outcomes of elderly patients with a high BMI undergoing cholecystectomy using the ERAS protocol and traditional perioperative care, focusing on various indicators, including fasting time, surgical outcomes, hospital stay, pain scores, satisfaction levels, readmission rates, postoperative symptoms, and functional capacity.

Research methods

A retrospective cohort study design was employed, involving 198 elderly patients with a high BMI who underwent cholecystectomy. The patients were divided into two groups: One managed using traditional perioperative care (non-ERAS protocol) and the other managed using the ERAS protocol. Data on relevant indicators were collected preoperatively, intraoperatively, and postoperatively, and a comparison of surgical outcomes was conducted.

Research results

The comparison results showed no statistically significant differences between the two groups in terms of age, sex, BMI, underlying diseases, surgical type, and preoperative hospital stay. However, the ERAS group had a significantly shorter preoperative fasting time. In terms of postoperative recovery, the ERAS protocol group exhibited significant advantages over the non-ERAS group, including shorter hospital stay, lower postoperative pain scores, hunger scores, and higher satisfaction levels. The readmission rate was also significantly lower in the ERAS protocol group. Furthermore, there

were significant differences in postoperative nausea and vomiting (PONV) severity, postoperative abdominal distention at 24 h, and daily life ability scores between the two groups.

Research conclusions

The study findings demonstrate that the ERAS protocol provides significant benefits in postoperative outcomes following cholecystectomy. It reduces readmission rates, improves PONV, alleviates abdominal distention, and enhances patients' functional capacity. Although the ERAS protocol may not show significant improvement in early postoperative symptoms, it exhibits advantages in long-term postoperative symptoms and recovery. Implementing the ERAS protocol in postoperative management is crucial for improving patients' recovery and quality of life while reducing health care resource utilization.

Research perspectives

The results highlight the importance of incorporating the ERAS protocol in the postoperative management of cholecystectomy patients. Further research can explore the long-term effects of the ERAS protocol on patient outcomes and assess its applicability in other surgical procedures or patient populations.

FOOTNOTES

Author contributions: Gu YX and Wang XY contributed equally in analysis of the data and writing of the manuscript; Yu H designed the study; Chen Y, Shao JX, Ni SX, Zhang XM, Shao SY, Zhang Y, Hu WJ, Ma YY, and Liu MY collected the data and corrected the paper; all authors have read and approved the final manuscript.

Supported by the Hongkou District Health Committee, No. Hong Wei 2002-08; and Discipline Promotion Program of Shanghai Fourth People's Hospital, No. SY-XKZT-2020-1021.

Institutional review board statement: The study was reviewed and approved by the Shanghai Fourth People's Hospital Institutional Review Board (Approval No. 2019047).

Informed consent statement: Patients were not required to give informed consent to the study because it is a retrospective study and the data came from electronic medical records in the hospital.

Conflict-of-interest statement: The authors declare no conflicts of interest for this article.

Data sharing statement: No additional data are available.

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S-Editor: Yan JP

L-Editor: Wang TQ

P-Editor: Yan JP

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