RESEARCH ARTICLE

Postoperative care of hepatocellular carcinoma patients based on enhanced recovery after surgery

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Hepatocellular carcinoma is the most common primary liver cancer worldwide with high morbidity and mortality, which seriously threatens the life and health of human beings. In the treatment of hepatocellular carcinoma, surgery is the main treatment mode. However, surgical treatment has certain risks. Postoperative recovery is often affected by a variety of factors, and the quality of care is crucial to the prognosis of patients. This study aimed to explore the effectiveness of enhancing postoperative recovery in postoperative care for patients with hepatocellular carcinoma. 140 patients admitted to the Hepatobiliary Surgery Department of Zhuhai People's Hospital from August 2018 to August 2019 were included in this study and divided into an experimental group and a control group with 70 patients in each group. The experimental group patients were given accelerated rehabilitation surgical care before, during, and after surgery to promote rapid postoperative recovery, which included preoperative nutritional assessment and optimization, preoperative patient education, strict management of intraoperative fluid input, intraoperative analgesia, early postoperative feeding, and encouragement of early activity. Patients in the control group were nursed by traditional nursing techniques. Anxiety score, pain control score, sleep score, intestinal ventilation time, and hospitalization cost were compared between two groups at 12 h, 24 h, 48 h, 72 h, and 1 week after surgery. The comparison of gender, age, and preoperative liver function reserve between the two groups showed no significant difference. There were significant differences in anxiety level, pain control, and sleep scores between the groups at 24 h after surgery ($P < 0.05$). There were statistically significant differences between the groups in the time of getting out of bed for activities, intestinal ventilation time, and hospitalization cost ($P < 0.05$). The difference of physical recovery between the groups was statistically significant ($P < 0.05$). The results showed that nursing for hepatocellular carcinoma patients using accelerated rehabilitation surgical techniques could reduce anxiety levels, improve pain control and sleep scores, as well as reduce hospitalization time and hospitalization costs.

Keywords: surgery; hepatocellular carcinoma; postoperative; nursing; physical recovery.

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Introduction

Liver cancer (LC) ranks second in the incidence rate and mortality rate of malignant tumors in China, posing a great threat to the health of residents. The mortality rate of primary LC is high, which seriously endangers the life safety of residents [1]. Hepatocellular carcinoma (HCC) belongs to a type of primary LC with a proportion of over 90% [2]. As medical imaging and other technologies continue to be updated and reformed, the treatment of HCC has also been

greatly improved. At present, the main method for treating HCC is surgical treatment. Hepatectomy is the first choice and best method for HCC treatment [3]. It can remove and repair tissues within the body that have the potential to develop into cancerous cells or have already undergone malignant transformation, thereby further promoting the recovery of the body [4]. However, there is a risk of new trauma during hepatectomy, and patients may experience new trauma and stress phenomena. These situations can limit the treatment effectiveness of patients, leading to a decrease in their postoperative recovery. The quality of care provided to patients during the postoperative recovery period can have a significant impact on their postoperative outcomes. Studies have confirmed that, although the postoperative mortality rate of HCC patients has improved, patients exhibit a higher incidence of complications after liver resection [5, 6]. Meanwhile, HCC patients may experience postoperative trauma and stress reactions due to pain and other factors after surgery. This requires patients to receive good care during HCC surgery. If patients receive good care during the perioperative period, the incidence of postoperative complications and stress reactions will be significantly improved. Therefore, the trauma caused during surgery and perioperative care are crucial for the smooth recovery of HCC patients after surgery.

Enhanced recovery after surgery (ERAS) refers to the use of a set of medical-based nursing measures to care for patients before, during, and after surgery, promoting rapid postoperative recovery. It has great application value in the perioperative period of LC [7]. ERAS can reduce the physiological and psychological trauma of HCC patients during the perioperative period and reduce their post-traumatic stress phenomenon [8]. ERAS not only requires the cooperation of patients but also the cooperation of medical staff from different departments including surgeons and anesthesiologists who perform surgeries, as well as rehabilitation doctors and nursing staff during postoperative recovery. Numerous studies have confirmed that ERAS can reduce intraoperative trauma and alleviate post-traumatic stress in the treatment of HCC patients [9, 10]. When applying ERAS, some principles need to be followed. For example, medical staff should have detailed communication with patients before surgery, and patients should undergo nutritional risk screening before surgery. During surgery, it is necessary to limit infusion volume and avoid patients' hypothermia. To improve patients' acceptance, they can avoid strict fasting and water deprivation before surgery or avoid routine intestinal preparation to reduce the incidence of adverse reactions. These measures can help patients recover intestinal function as soon as possible, wake up early, and achieve sufficient pain relief effects. Although ERAS has achieved significant results in the treatment of HCC patients, there is still no unified standard for this method. In clinical applications, ERAS lacks standards and measurement tools that can reflect nursing effectiveness. Therefore, in the evaluation of the effectiveness of ERAS application, researchers often use hospital stay, first exhaust time, and postoperative patient bed activity time. In response to this issue, the evaluation objects of the nursing outcomes classification (NOC) include patients, corresponding families, and communities [11]. NOC is a set of systematic care outcome classification tools used to assess the impact of a care intervention on a patient's health status. NOC was founded in the 1990s by nurses and nursing scholars at the University of Iowa, Iowa city, Iowa, USA, a leading institution in the field of nursing education and research and dedicated to advancing the science of nursing. NOC applications and standards mainly include four aspects of care assessment and planning, care quality improvement, education and training, and research tools, which uses different measurement scales to display the effectiveness of outcomes before and after nursing, specifically demonstrating the effectiveness and work value of nursing [12].

To objectively and continuously evaluate the effectiveness of ERAS in the treatment of HCC

patients, this study used NOC to score the effectiveness of accelerated rehabilitation surgery in the postoperative care of HCC patients. The effects of this technique on postoperative anxiety level, pain control, sleep quality, intestinal ventilation time, and hospitalization cost were analyzed to provide a reference for clinical nursing practice. Through this approach, the research investigated the value of ERAS in the postoperative care of HCC patients and systematically evaluated the impact of accelerated rehabilitation surgery technology on the postoperative care of HCC patients. This research not only provided empirical support for clinical care but also the new ideas and methods for future nursing practice, aiming to better serve the high-risk patient group.

Materials and methods

Research objects

A total of 300 patients admitted to the Department of Hepatobiliary Surgery of Zhuhai People's Hospital (Zhuhai, Guangdong, China) from August 2018 to August 2019 were randomly selected as the study subjects. The patient's inclusion criteria included (1) patients who met the clinical disease diagnosis criteria for LC; (2) TNM staging was I-II stage; (3) the Child-Pugh grading of liver function before surgery was A or B; (4) the age range was between 18 and 80 years old. The exclusion criteria included (1) patients who do not meet the clinical diagnostic criteria for HCC; (2) under 18 or over 80 years old; (3) patients with functional disorders such as heart, lungs, and kidneys; (4) patients with other malignant tumor diseases. After screening, 140 eligible patients were involved in this study with 70 patients in experimental group (EG) and another 70 patients in control group (CG). EG patients received ERAS care before, during, and after surgery, while CG patients adopted routine nursing techniques for care. All procedures of this research were approved by the Ethics Committee of Zhuhai People's Hospital (Zhuhai, Guangdong, China).

ERAS methods

The implementation of ERAS requires a close collaboration between the surgeon, anesthesiologist, and nursing team to develop a personalized care plan through multidisciplinary collaboration. The main components of ERAS include preoperative preparation, intraoperative management, and postoperative care. Preoperative preparation included a comprehensive nutritional assessment to the patient and provided necessary nutritional support for malnourished patients such as oral nutritional supplements or intravenous nutrition to improve their nutritional status before surgery. By communicating in detail with patients and their families about the surgery and its expected outcomes, possible pain, and recovery, patients' anxiety was expected to be reduced, thereby increasing confidence in the surgery. Patients did not need to strictly fast before surgery and adopted a clear diet to help reduce preoperative hunger and improve postoperative recovery speed. Intraoperative management involved multi-modal analgesia strategies including local anesthesia, nerve blocks, and analgesics used to reduce postoperative pain and anesthesia-related complications. During the operation, excessive infusion should be avoided to reduce the risk of postoperative edema and complications, while the physiological state of the patient was monitored and adjusted flexibly. The patient's body temperature should be kept constant to prevent postoperative fever and related complications. Postoperative care included resuming oral feeding in the early postoperative period, usually within 6 hours after surgery, to promote intestinal function recovery and reduce the risk of complications. Patients were encouraged to get out of bed and move around as early as possible after surgery, usually within 24 hours, to reduce blood clots, pulmonary complications, and accelerate intestinal peristalsis. After the operation, a monitoring mechanism was established to evaluate patients' pain management, sleep quality, intestinal ventilation, and complications, and corresponding measures were taken in time.

Observation of indicators and surveys

The indicators included anxiety scores, pain control scores, sleep scores, time to get out of bed after surgery, intestinal ventilation time, postoperative hospitalization days, hospitalization expenses, and patient care satisfaction for both groups at 12 h, 24 h, 48 h, 72 h, and 1 week after surgery. A general situation questionnaire, an evaluation form for postoperative care of LC patients, a patient satisfaction questionnaire, and an evaluation form for postoperative physical recovery were used in this study. The patient's general situation questionnaire covered patient general information and patient surgical information, which included age, gender, surgical method, surgical time, *etc*. The evaluation form for postoperative care of LC patients was determined by expert consultation. According to the concept of NOC, the importance of each indicator involved in the satisfaction scale was graded based on expert opinions. A patient satisfaction questionnaire was developed through coefficient analysis and reliability and validity testing of expert opinions. This scale mainly included three health areas of anxiety level, pain control, and sleep, as well as six aspects of communication, safety, guidance, physical condition, nursing, and nursing techniques. The scale adopted the Likert 5-level scoring method to score patient satisfaction. A score of 1 indicated complete dissatisfaction, while a score of 5 indicated extreme satisfaction. The postoperative physical recovery evaluation table was used to evaluate the postoperative physical recovery of patients, which included dimensions such as endurance, preservation of physical strength, psychomotor energy, rest, sleep, pain control, and postoperative rehabilitation status. Each dimension was refined into different entries with a total of 83 observation entries.

Statistical analysis

Microsoft Excel (2013) (Microsoft, Redmond, WA, USA) and SPSS 22.0 (IBM, Armonk, NY, USA) were employed for data processing and analysis. The data were expressed as mean ± standard deviation and frequency. Chi square analysis was applied for intra-group comparison. The patient satisfaction with nursing care was calculated using mean ± standard deviation. Repeated measurement analysis of variance was used to compare the physical recovery of patients at different time points [13]. P value less than 0.05 indicated statistical differences in the data.

Results

Comparison of baseline characteristics

There were no significant differences in age, gender, liver function reserve before operation and surgical methods between the EG and the CG ($P > 0.05$) (Table 1).

Comparison of anxiety level, pain control, and sleep scores

The scores of anxiety level, pain control, and sleep between two groups of patients at different time points after surgery were compared (Figure 1). The results showed an upward trend in both groups after surgery. The difference of postoperative time effect between EG and CG was statistically significant ($P < 0.01$). Without considering the grouping factors, with the increase of time, the scores of anxiety level, pain control, and sleep before and after surgery had statistically significant differences ($P < 0.01$). Under the influence of grouping factors, the score differences in different postoperative periods were statistically significant ($P < 0.01$). Compared the two groups, the scores of anxiety level, pain control, and sleep in the EG and the CG were statistically significant ($P < 0.01$).

Comparison of postoperative observation indicators

The postoperative hospitalization time of the EG was 8.75 ± 0.65 days, while that of the CG was 14.59 ± 1.81 days. The postoperative hospitalization time of the two groups showed statistically significant difference ($P < 0.01$). The patients in the EG could get out of bed on the first day after surgery, while the patients in the CG could get out of bed on the 2-3 days after surgery.

Table 1. General information comparison of two groups.

Item	EG	CG	Inspection value	*P*-value
Age (years old)	56.32 ± 12.13	55.26 ± 13.52	$T = 0.621$	0.463
Gender	60 males and 10 females	55 males and 15 females	$\chi^2 = 2.258$	0.235
TNM-I	47	38	$\chi^2 = 0.76$	0.286
TNM-II	23	32		
ASA-I	50	46	$\chi^2 = 1.548$	0.357
ASA-II	20	24		
Child-pugh A	52	10	$\chi^2 = 0.354$	0.714
Child-pugh B	18	60		
Partial hepatectomy	53	55	$\chi^2 = 1.398$	0.631
Left lateral lobectomy	7	9		
Hemihepatectomy	10	6		
Tumor size (cm)	7.93 ± 3.01	8.38 ± 2.58	$t = 1.213$	0.423
Operative time (min)	168.22 ± 38.96	171.23 ± 37.25	$t = 1.526$	0.257
Intra-operative bleeding (mL)	198.01 ± 287.58	234.13 ± 276.34	$t = 0.637$	0.637
Intra-operative blood transfusion (case)	3	6	$\chi^2 = 0.451$	0.486

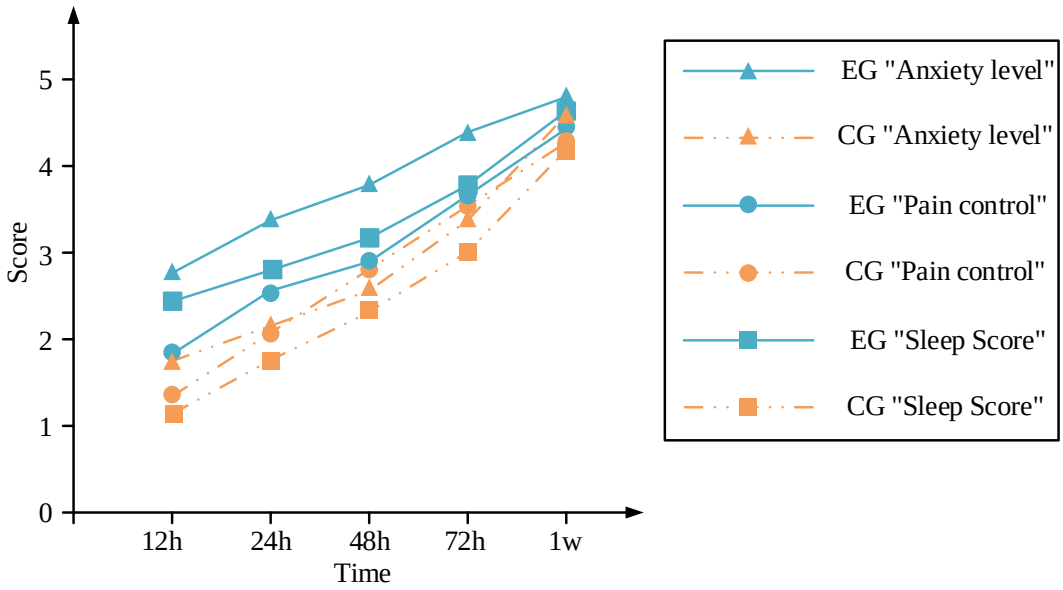

Figure 1. The average number of postoperative anxiety levels, pain control, and sleep for two groups of patients.

The difference in the time of getting out of bed after surgery between the two groups was statistically significant ($P < 0.01$). The intestinal ventilation time of the EG was 35.26 ± 6.78 h, and that of the CG was 54.29 ± 13.89 h. The difference of postoperative intestinal ventilation time between the two groups was significant different ($P < 0.01$). The hospitalization cost of the EG was ¥(5.31 ± 2.35) × 10^4, and that of the CG was ¥(6.52 ± 3.14) × 10^4. The difference of hospitalization cost between the two groups was statistically significant ($P < 0.01$). The pain score of the EG was 3.01 ± 0.25 at 48 hours after surgery, and that of the CG was 3.96 ± 0.78 (P<0.01) (Table 2).

Table 2. Comparison of observation indicators.

Item		EG	CG	Inspection value	*P*-value
Postoperative hospitalization time (day)		8.75 ± 0.65	14.59 ± 1.81	t = 19.23	0.001
Time to get out of bed and engage in activities	On the 1st day after surgery	15	2	χ^2 = 41.921	0.004
	On the 2nd day after surgery	30	9		
	On the 3rd day after surgery	25	59		
Intestinal ventilation time (hour)		35.26 ± 6.78	54.29 ± 13.89	t = 9.36	0.002
Hospitalization cost (¥10,000)		5..31 ± 2.35	6.52 ± 3.14	t = 3.21	0.006
Pain score at 48 hours after surgery		3.01 ± 0.25	3.96 ± 0.78	t = 20.11	0.005

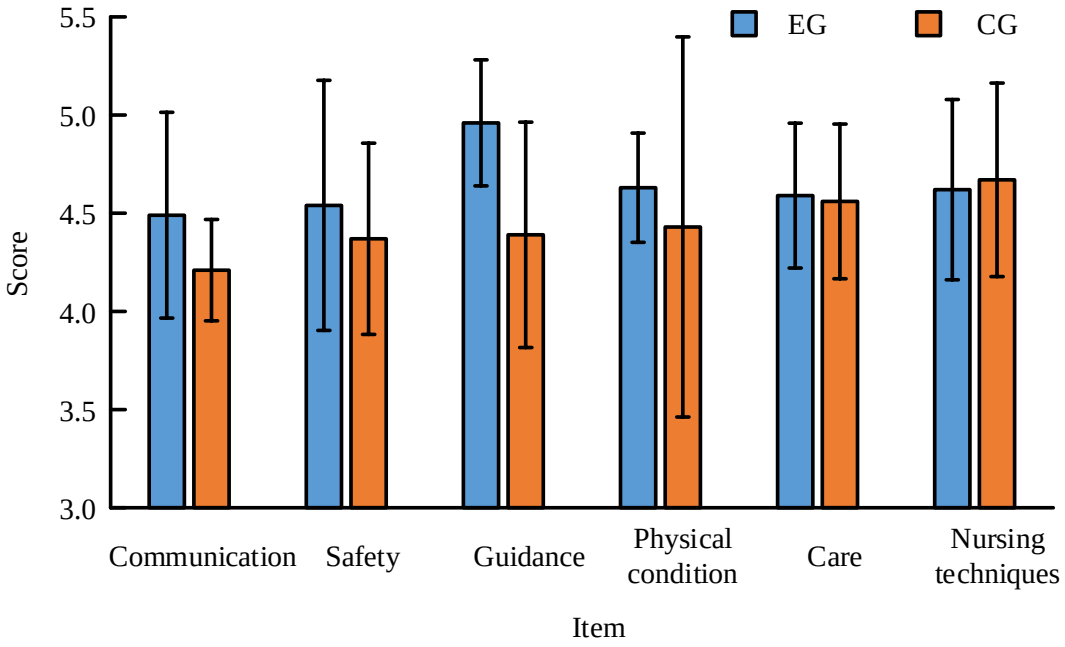

Figure 2. Satisfaction scores.

Comparison of nursing satisfaction scores

The communication score of the EG was 4.49 ± 0.524, which was higher than 4.21 ± 0.258 of the CG (P < 0.05). The safety score of the EG was 4.54 ± 0.637 and was higher than that of the EG's 4.37 ± 0.487 with significant difference (P < 0.05). The guidance scores of the EG and CG were 4.96 ± 0.321 and 4.39 ± 0.574, respectively, with significant difference between the two groups (P < 0.05). The scores of physical conditions in the EG and the CG were 4.63 ± 0.278 and 4.43 ± 0.968, respectively, and there was a statistically significant difference between the two groups (P < 0.05). The nursing score of the EG was 4.59 ± 0.369, while that of the CG was 4.56 ± 0.394. There was no difference between the two groups. The nursing technical score of the EG was 4.62 ± 0.459, and that of the EG was 4.67 ± 0.493. There was also no significant difference in nursing technical score between the two groups (Figure 2).

Comparison of postoperative physical recovery

The comparison results of the dimensions of endurance (Figure 3a), physical preservation (Figure 3b), psychomotor energy (Figure 3c), and rest (Figure 3d) of the two groups at 5 time points demonstrated that the endurance score of the EG was 3.2 points, which was higher than that of the CG 3.0 points (P < 0.05). The score of

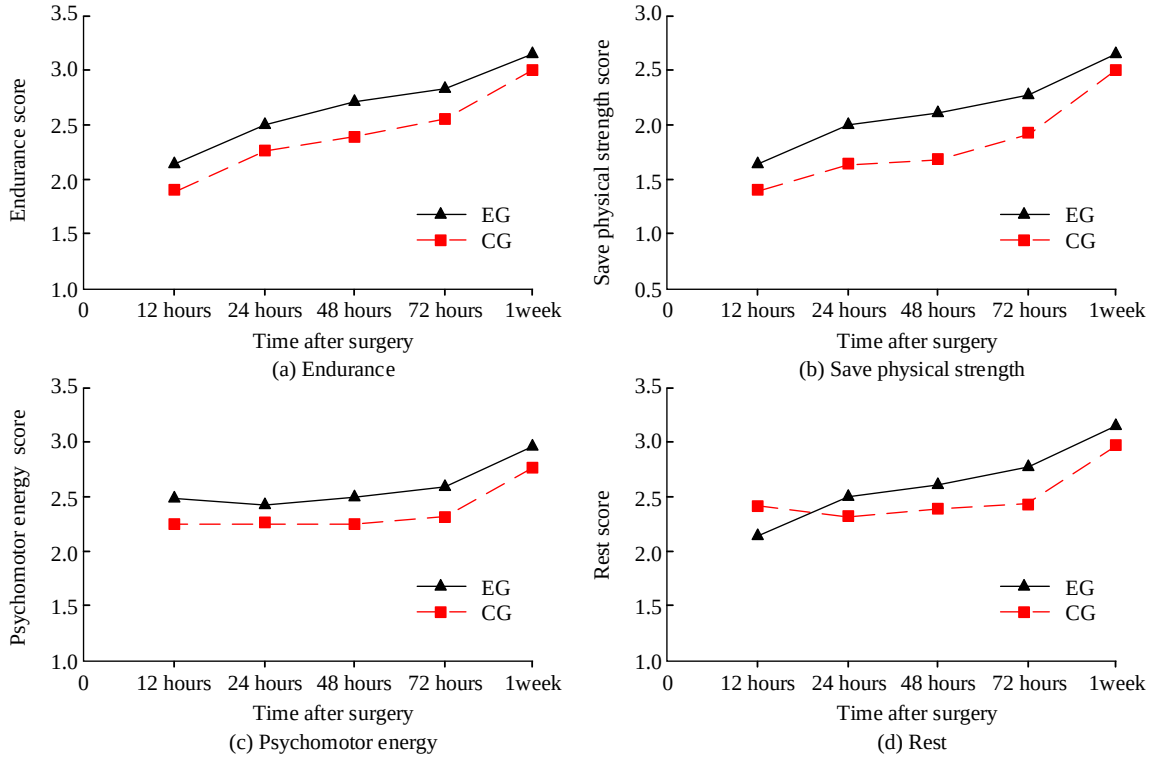

Figure 3. Comparison of endurance, energy conservation, psychomotor energy, and rest.

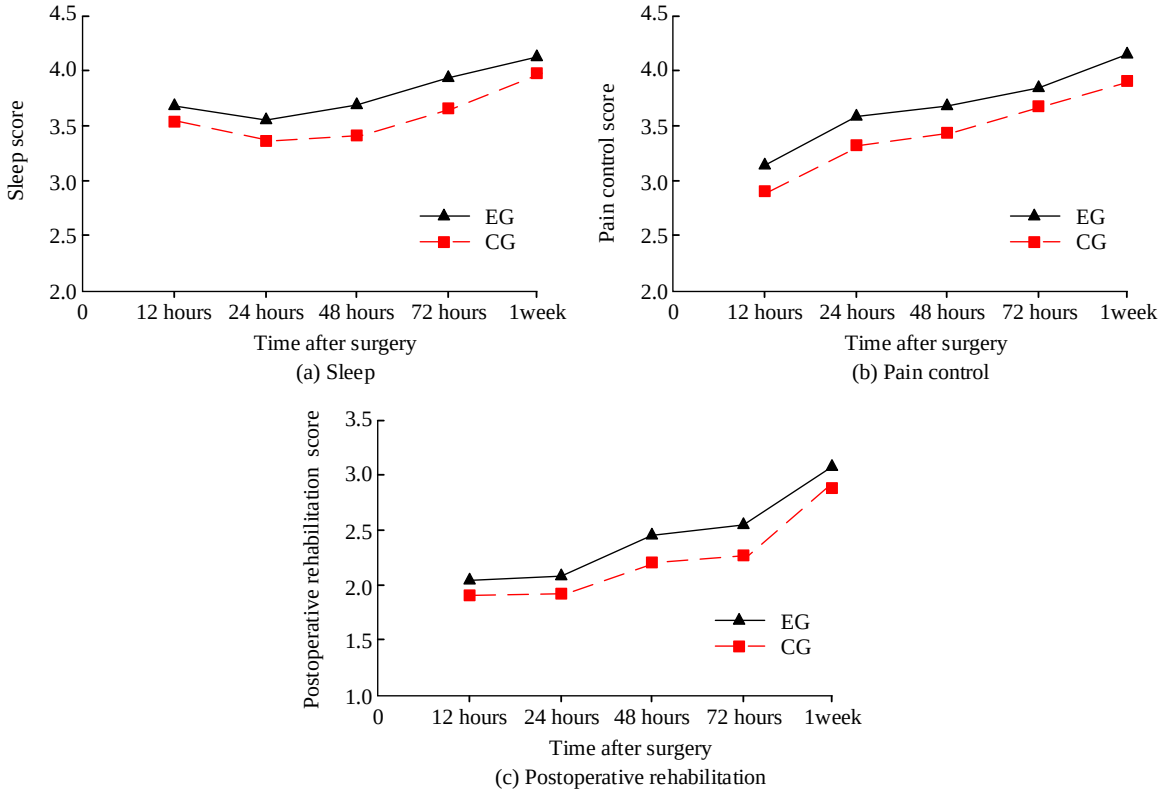

Figure 4. Comparison of sleep, pain control, and postoperative rehabilitation.

preserved physical strength in the EG was 2.7 points, which was also higher than that in the CG 2.5 points ($P < 0.05$). The psychomotor energy score of the EG was 2.9 points, while that of the CG was 2.7 points. There was a significant difference between the two groups ($P < 0.05$). The rest score of the EG was 3.2 points, and that of the CG was 3.0 points, which also showed significant difference ($P < 0.05$). The results of repeated measurement analysis of variance showed that there was an interactive effect between the time and group of two groups. The comparison results of the dimensions of sleep, pain control, and postoperative rehabilitation status of the two groups at 5 time points showed that the sleep score of the EG was 4.2 points and that of the CG was 3.9 points ($P < 0.05$) (Figure 4a). The pain control scores of the EG and the CG were 4.2 points and 3.9 points, respectively, with significant difference ($P < 0.05$) (Figure 4b). The scores of rehabilitation state in the EG were 3.1 points and 2.9 points in the CG with significant difference between the two groups ($P < 0.05$) (Figure 4c). The results of repeated measurement analysis of variance showed that there was an interactive effect between the time and two groups.

Discussion

Due to the high mortality rate and rapid progression of LC, LC patients are prone to negative emotions and lose confidence in treatment [14]. In addition, patients are in a low mood and have anxiety about surgery after diagnosis, indicating that surgery generally causes concern for patients. Previous studies have confirmed that LC patients may develop pessimistic and negative emotions during treatment due to factors such as rapid disease progression, susceptibility to recurrence, and high mortality rates [15, 16]. In addition, due to the high cost of LC treatment, patients may experience increased anxiety due to their family's financial level [17, 18]. ERAS adopts a series of optimization measures to help patients alleviate psychological and traumatic stress, thereby promoting their recovery. Most studies have corroborated that ERAS has been met with unanimous approval from patients and their families in clinical settings [19]. In the postoperative care of ERAS, good psychological support can help patients reduce trauma and stress [20]. Further, this method does not emphasize fasting throughout the night before surgery but emphasizes eating fewer and more nutritious foods to provide patients with nutritional support [21]. When applying ERAS, attention should be paid to the patient's sleep quality, and appropriate analgesic measures should be taken, which is beneficial for the patient's mental and physical recovery. In the recovery stage after surgery, this concept advocates minimizing the use of catheters as much as possible, which is beneficial for reducing the probability of exogenous infections [22]. The concept of restrictive fluid replacement is also helpful for the postoperative recovery of patients, which is beneficial for them to get out of bed and move around as soon as possible [23]. In the postoperative physical recovery of liver-derived LC patients, the scores of endurances, energy conservation, psychomotor energy, rest, sleep, pain control, and postoperative rehabilitation status dimensions were all improved. Therefore, the application of ERAS could effectively improve the postoperative physical recovery of patients. This technology has a high advantage in postoperative care for LC patients.

From the comparison of anxiety scores between EG and CG at 12, 24, 48, and 72 hours after surgery, patients mainly worried about pain during or after surgery before operation. After introducing the concept of accelerated rehabilitation surgery, the postoperative pain of patients was controlled within a tolerable range, thereby reducing their overall anxiety. Through ERAS, nursing staff informed patients of detailed treatment methods and procedures, which greatly reduced their anxiety during and after surgery, and patients could easily establish confidence in overcoming the disease. One week after surgery, the patient's condition improved

during this stage with pain relief and increased confidence in recovery, further reducing anxiety levels. There was a significant difference in pain control scores between EG and CG. EG patients received anti-inflammatory drugs 1 - 3 days before surgery, local anesthesia, and analgesia during surgery, and multi-modal analgesia after surgery. The nursing staff responded accordingly to the patient's pain perception. The pain health education received by patients had been strengthened, and timely feedback on pain to nursing staff had been provided for corresponding treatment and care. After one week, the patient had the catheter removed, and their constraints during eating and getting out of bed activities decreased. In addition, their sleep improved, and their pain significantly decreased. Patients should maintain sufficient sleep time after surgery. Being in a sleep state could alleviate pain in patients. Improving sleep quality could accelerate physical recovery. From the postoperative sleep scores of EG and CG patients at 12 h, 24 h, 48 h, 72 h, and 1 week,the results showed that pain could affect sleep quality when patients had just undergone surgery. Under ERAS, patients could improve their sleep quality by reducing pain and advancing intestinal ventilation time. One week after surgery, the patient's condition improved, and the sleep quality could also return to the pre-disease level. When applying ERAS, it is necessary to strengthen communication between medical staff and patients, informing them of the significance and process of the technology. Detailed preoperative briefing on HCC is beneficial for alleviating patients' anxiety. Medical staff also need to communicate with the patient's family members to inform them of potential issues and related rehabilitation measures that may arise after HCC surgery [24]. Medical staff can inform patients and their families that ERAS can effectively shorten hospital stays, reduce treatment costs, and accelerate postoperative recovery. This measure can reduce the unfamiliarity and psychological conflict of patients and their families toward surgical treatment, thereby alleviating patients' anxiety and fear. Due to the large wound size of LC surgery, patients may experience a decrease in sleep quality after surgery due to pain [25, 26]. This may be due to the large release of inflammatory pain-causing substances in the tissue. This study confirmed that, after the application of ERAS, patients' pain perception had been effectively alleviated, pain control had been achieved, and their sleep conditions had also been improved. To alleviate patients' pain and improve their sleep quality, medical staff can provide pain health education based on the patient's situation, which helps patients to provide timely feedback on their pain situation and receive corresponding care and treatment, thereby improving the quality of postoperative care. During this process, medical staff can remove the catheter as early as possible or reduce its use according to the patient's condition, thereby reducing discomfort and pain when the catheter arrives. By reducing patients' pain, their sleep quality has also been improved, thereby enhancing their comfort and facilitating their postoperative recovery. If necessary, medication can be given to patients with poor sleep quality. Improving sleep quality can also reduce patients' sensitivity to pain. After LC surgery, patients may present with a reduction in appetite, bloating, and other conditions for various reasons. This can lead to a decrease in nutrient absorption, which is an unfavorable factor in the patient's recovery process. ERAS abandons traditional fasting methods and strives to provide patients with nutritional support as much as possible. If the patient does not show any gastrointestinal reactions such as bloating or vomiting after surgery, medical staff can provide some liquid food to eat less and eat more meals, and then gradually provide regular services, which can promote the patient's intestinal peristalsis and maintain the normal function of the intestinal mucosa. In this study, the postoperative bedtime and ventilation time of patients were advanced, and the hospitalization time and treatment cost of patients were reduced. The patient's satisfaction with nursing increased. These results confirmed that the application of ERAS could effectively promote postoperative recovery in HCC patients and

reduce treatment costs, which had positive implications for patients and their families.

The implementation of ERAS allows nursing staff to educate patients on the meticulous techniques and procedures involved in their treatment, which facilitates the development of a sense of control and empowerment, thereby reducing postoperative anxiety. Strengthening postoperative pain control can also improve the patient's postoperative sleep quality and promote their recovery. Therefore, ERAS can be applied to the postoperative care of patients with liver-derived LC and is worthy of clinical promotion. Although this study confirmed the high clinical significance of ERAS in the surgical treatment of LC patients, there were still some issues with it. Due to time constraints, the number of samples collected in the study was relatively small, and the patient's recovery status was not tracked. Therefore, more data were needed for validation and timely tracking of the patient's recovery status. In addition, the postoperative complications and readmission rates of patients had not been analyzed. Further improvement of the experimental content was needed in the future to improve the research completeness.

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