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Original Article

Post-surgical, enhanced recovery in partial hepatectomy patients

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Abstract: Objective: This study was designed to explore the effects of enhanced recovery after surgery (ERAS) in the perioperative period among partial hepatectomy patients. Method: Eighty partial hepatectomy patients with liver cancer admitted to our hospital were randomly divided into a study group (SG, n=40, who underwent ERSA) and a control group (CG, n=40, who underwent conventional nursing). The postoperative recovery indicators, the pain intensity, the self-care abilities, and the incidences of complications were compared between the two groups, and the patients' and doctors' satisfaction with the nurses' performance was evaluated. Results: The recovery of bowel sound, the passage of gas through the anus, the out-of-bed activities, the lengths of the postoperative hospital stays, the pain intensity at 12 h, 24 h, and 48 h after surgery, the total incidences of complications, as well as the medical expenses were lower in the SG than they were in the CG ($P < 0.05$). The patients in the SG showed higher self-care abilities at 1 d, 2 d, and 3 d after surgery ($P < 0.05$). The patients in the SG and their physicians were more satisfied with the nursing ($P < 0.05$). The two groups were not statistically different in their readmission rates at 30 d after the surgery ($P > 0.05$). Conclusion: Among patients undergoing partial hepatectomy, ERSA helps accelerate the postoperative recovery, helps reduce the pain intensity and the incidence of complications, and helps improve the self-care abilities and nursing satisfaction among partial hepatectomy patients.

Keywords: ERSA, partial hepatectomy, perioperative period, applied research

Introduction

Liver cancer is a common malignant tumor in the digestive system with a higher incidence in males than in females. In terms of its incidence and mortality, it ranks sixth and second in the global list of cancers, and fourth after lung cancer, gastric cancer, and esophageal cancer and third after lung cancer and gastric cancer in China. Studies have pointed out that the incidence and mortality of liver cancer patients in China are significantly higher than they are in other countries, accounting for about 50% of the global cases [1-3].

Partial hepatectomy is a commonly-performed operation and a main method of treating primary liver cancer. If it is well performed, the patients' survival and quality of life can be significantly improved [4, 5]. However, it is found in clinical practice that the difficulty of partial hepatectomy and the risks in the perioperative period will be significantly increased due to the fact that most patients with liver cancer are also suffering from chronic viral hepatitis and cirrhosis to varying degrees. Although in recent years, due to the development of modern medical science, the perioperative mortality of patients with partial hepatectomy has been controlled in the range of 1%-3%, postoperative complications are still reported in over 30% of the patients, affecting the prognosis [6-8]. Therefore, the proper management of patients in the perioperative period of partial hepatectomy can alleviate the postoperative stress and improve the effectiveness and safety of hepatectomy.

Enhanced recovery after surgery (ERSA) adopts a series of nursing measures supported by evidence-based medicine (EBM) to reduce surgical stress and the postoperative incidence of complications, and to reduce metastasis and the development of diseases. It was first put forward and applied clinically in 2001, and has proven successful after years of clinical prac-

tice [9, 10]. This study aimed to explore the effects of ERSA in the perioperative period of partial hepatectomy patients and its possibility of improving the surgical stress, so as to provide clinical references for reducing the disease's postoperative metastasis and development.

Materials and methods

General clinical data

Eighty partial hepatectomy patients admitted to our hospital from January 2017 to December 2019 were randomly divided into the study group (SG, n=40) and the control group (CG, n=40).

Inclusion criteria: (1) Patients with an accurate clinical diagnosis and in need of a partial hepatectomy, (2) Patients with a clear consciousness enabling them to cooperate with the study, (3) Patients who were undergoing the surgery for the first time, (4) Patients with general anesthesia and ASA classes I-II. (5) Patients ≥18 years old, and (6) Patients with complete medical records. This study was approved by the Ethics Committee of Bozhou People's Hospital of Anhui Province. Informed consent was provided by all the patients or their family members.

Exclusion criteria: (1) Patients with complications such as mental diseases, severe organic diseases, communication disorders, biliary obstructions, or hypercholesterolemia, and (2) Patients with liver cancer recurrence or distal metastasis.

Removal criteria: (1) Patients who failed to pay a return visit during the study, (2) Patients who were required to withdraw during the study, and (3) Patients with severe complications after the surgery who had to be treated in the ICU.

Methods

The patients in the CG were conventionally intervened in the perioperative period of partial hepatectomy, including preoperative routine health education, mechanical bowel preparation, fasting from solids and liquids, and the postoperative encouragement of early activities, *etc*. No specific plans or requirements were formulated.

The nursing scheme developed for the patients in the SG was the same as in the CG but with ERSA added as follows: (1) The establishment of an ERSA group. Through a literature search and by consulting medical records, *etc*., the common complications of patients requiring partial hepatectomy were identified, and the key points in nursing were determined. (2) Preoperative intervention: using health education, the content, measures, and significance of ERSA were introduced to the patients to improve their nursing compliance. (3) Intraoperative intervention: intervention in the operation room is a main part of ERSA. According to published research, low body temperatures and central venous pressure, liquid management, and infection are the main factors affecting the prognosis. Accordingly, the ERSA measures in the operation room were analyzed: ① Prevent hypothermia during the surgery. During the surgery, the room temperature and humidity must be kept constant. The patient's exposed skin can be warmed by a heater or covered by an electric blanket or quilt to minimize the patient's loss of intraoperative body heat. Afterward, the saline used for intraoperative irrigation should be properly heated to maintain the temperature at about 38-40°C and the infusion liquid should also be pre-heated. ② Intraoperative prophylaxis of deep vein thrombosis. Elastic socks should be worn by the patients before the surgery, and leg compression should be used to prevent the formation of deep vein thrombosis during the surgery. ③ Controlled low central venous pressure. During the surgery, the nurses should closely cooperate with the surgeons and anesthesiologists to maintain a good low central venous pressure, so as to reduce the intraoperative blood loss and speed up the patients' postoperative recoveries. ④ Intraoperative fluid management. Intraoperative fluid management should be strictly performed to ensure the maintenance of the central vascular blood volume, ensure the normal function of the vital organs, avoid the excessive intake of fluids and electrolytes, and implement individual and target-oriented infusions. ⑤ Prophylactic use of antibiotics. In view of the high risk of infection in patients undergoing partial hepatectomy, intravenous antibiotics should be prophylactically administered during the surgery to ensure a reduction in the postoperative infection rate.

Observation indicators and evaluation criteria

Intergroup comparison of the general operation indicators: The postoperative time to recovery of bowel sounds, the first passage of gas through the anus, the out-of-bed activities, and the lengths of the hospital stays were recorded and compared between the two groups.

Intergroup comparisons of the postoperative pain intensity: The pain intensity was evaluated in both groups using the Changhai Pain Scale upon admission and at 1 d, 2 d, and 3 d after surgery. The Changhai Pain Scale is a comprehensive means of pain evaluation based on a 0-10 scale on the Numerical Rating Scale (NRS) and the description in words is easy to understand in the Verbal Rating Scale (VRS). The scale ranges from 0 to 10 and is positively correlated with pain intensity [11].

Intergroup comparison of the preoperative and postoperative self-care abilities: The self-care abilities were evaluated using the Barthel index (BI) upon admission and at 1 d, 2 d, and 3 d after surgery. BI is currently a highly effective self-care ability evaluation index with the widest clinical application. Containing 10 items, the scale assigns scores up to 100 to patients based on the degree of assistance they need to complete the requirements. A higher score indicates better self-care abilities [12].

Intergroup comparison of the postoperative complications: The postoperative complications were divided into general complications (nausea and vomiting, abdominal distension and pain, pulmonary infection, infection of the incisional wound) and specific complications (biliary fistula and abdominal dropsy), separately recorded and compared between the two groups.

Intergroup comparison of the readmission rate and the medical expenses: All the patients were followed up for 30 d to record their readmission rates and medical expenses for the intergroup comparisons.

Evaluation of the nursing satisfaction: The patients' and doctors' satisfaction with the nurses' performance were evaluated separately. The scale used to evaluate' the patients' satisfaction with the nursing includes 20 communication, instruction, symptom control, and nursing skill items. A Likert 5-point scale was used, and its results were positively related to the degree of satisfaction. The scale used to evaluate the doctors' satisfaction with the nursing consisted of 24 items in 5 dimensions with a total possible score of 120. A higher score represents a higher degree of satisfaction.

Statistical analysis

The statistical analysis was performed with SPSS 22.0. In the case of numerical data expressed as the mean ± standard deviation (mean ± SD), the comparison studies were carried out using Student's t tests In the case of nominal data expressed as [n (%)], the comparison studies were carried out using X^2 tests for the intergroup comparisons. GraphPad Prism 8 was used to draw the graphs in the study. For all the statistical comparisons, significance was defined as $P < 0.05$ [13].

Results

Intergroup comparison of general clinical indicators

The two groups were not statistically different in their general clinical data, such as gender, age, weight, marital status, educational background, or occupation ($P > 0.05$) (**Table 1**).

Intergroup comparison of the postoperative pain intensity

The recovery of bowel sounds, passage of gas through the anus, out-of-bed activity, and the lengths of the postoperative hospital stay scores in the SG were lower in the SG than they were in the CG ($P < 0.05$) (**Figure 1**).

Intergroup comparison of the postoperative pain intensity

Upon admission, the pain intensity scores were not significantly different between the two groups ($P > 0.05$). At 12 h, 24 h, and 48 h after surgery, the pain intensity scores in the SG were lower in the SG than they were in the CG ($P < 0.05$). At 72 h after surgery, the pain intensity scores of the two groups were basically the same ($P > 0.05$) (**Figure 2**).

Intergroup comparison of the preoperative and postoperative self-care abilities

Upon admission, the BI of the two groups were not significantly different ($P > 0.05$). At 1 d, 2 d,

Table 1. Intergroup comparison of the general clinical data ($\bar{x} \pm s$)/[n (%)]

General clinical data		SG (n=40)	CG (n=40)	t/X^2	*P*
Gender	Male	27	26	0.056	0.813
	Female	13	14		
Average age (years)		53.98±3.33	54.01±3.29	0.041	0.967
Average weight (kg)		63.49±4.33	63.34±4.29	0.156	0.876
Average BMI (kg/m^2)		21.29±3.21	21.31±3.01	0.029	0.977
Occupation	Farmer	10	10	0.343	0.801
	Worker	13	14		
	Other	17	16		
Educational background	Illiterate	4	5	0.419	0.778
	Elementary school	10	9		
	Junior middle school	13	12		
	Senior high school, college and university	13	14		
Marital status	Married	37	36	0.157	0.692
	Unmarried	3	4		
Smokes	Yes	23	24	0.052	0.82
	No	17	16		
Drinks alcohol	Yes	22	21	0.05	0.823
	No	18	19		
TNM	I	31	30	0.069	0.793
	II	9	10		
ASA	I	32	31	0.075	0.785
	II	8	9		

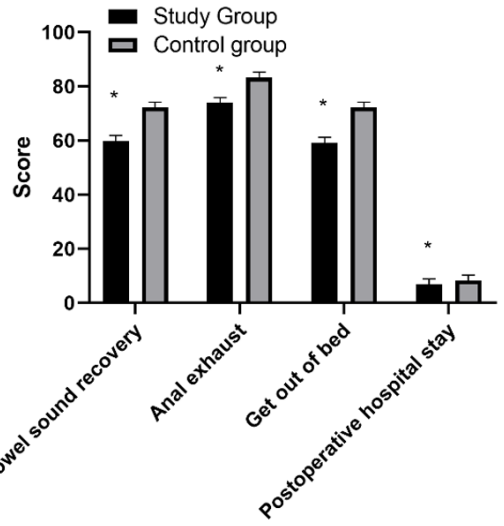

Figure 1. Intergroup comparison of the general surgical indicators. The SG showed shorter times to the recovery of bowel sounds, the first passage of gas through the anus, and out-of-bed activity as well as shorter lengths of the postoperative hospital stays in the SG than in the CG ($P < 0.05$). *$P < 0.05$ vs CG.

and 3 d after surgery, the BI of the SG was markedly higher than it was in the CG ($P < 0.05$) (**Figure 3**).

Intergroup comparison of the postoperative complications

The general complications totaled up to 4 in the SG (2 cases of nausea and vomiting, 2 cases of abdominal distension and pain) and 13 (6 cases of nausea and vomiting, 5 cases of abdominal distension and pain, 1 case of pulmonary infection, 1 case of infection of the incisional wound) in the CG ($P < 0.05$). The special complications were 2 (1 case of biliary fistula, 1 case of abdominal dropsy) in the SG and 3 (2 cases of biliary fistula, 1 case of abdominal dropsy) in the CG ($P < 0.05$). The total incidence of complications was 15.00% in the SG and 40.00% in the CG ($P < 0.05$) (**Figure 4**).

Intergroup comparisons of the readmission rate and medical expenses

One patient in the SG and 2 patients in the CG were readmitted to hospital at 30 days after surgery (2.50% vs 5.00%) (X^2=0.346, $P > 0.05$). The average medical expenses were RMB (41000±3100) in the SG and RMB (55100±3400) in the CG (t=19.382, $P < 0.05$).

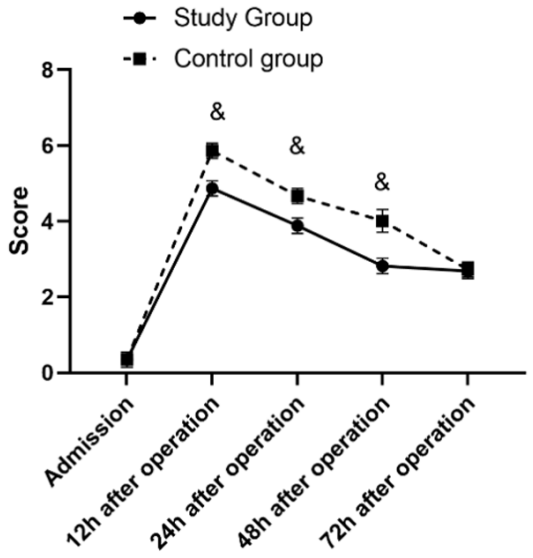

Figure 2. Intergroup comparison of the postoperative pain intensity. Before the surgery and at 72 h after the surgery, the two groups were not significantly different in their pain intensity ($P > 0.05$). At 12 h, 24 h, and 48 h after the surgery, the pain intensity in the SG was lower in the SG than it was in the CG ($P < 0.05$). &$P < 0.05$ vs CG.

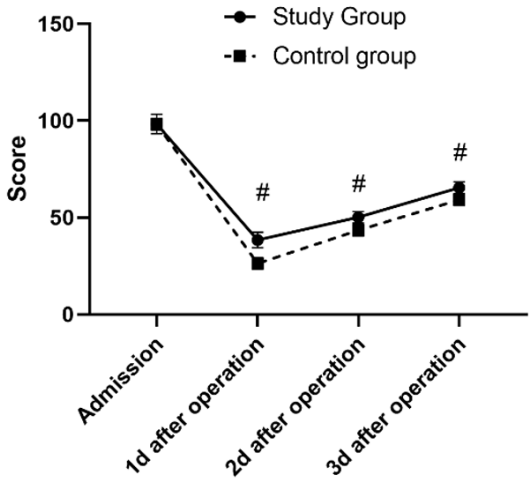

Figure 3. Intergroup comparison of the self-care abilities before and after the surgery. Upon admission, the BI of the two groups were not significantly different ($P > 0.05$). At 1 d, 2 d, and 3 d after surgery, the BI of the SG was markedly higher than it was in CG ($P < 0.05$); #$P < 0.05$ vs CG.

Intergroup comparison of nursing satisfaction

The patients and physicians in the SG were more satisfied with the nursing than the patients and doctors in the CG ($P < 0.05$) (**Figure 5**).

Discussion

Partial hepatectomy is a commonly-used surgical method for the treatment of primary or secondary benign or malignant tumors in the liver, and is considered to be the main abdominal surgery with a high incidence of complications and mortality. Although in recent years, the management concepts and methods employed in the perioperative period of partial hepatectomy have been continuously reformed, the incidence of complications still remains as high as 14%-55%, and about 0%-11.9% of the patients died within 30 d of the surgery [14, 15]. Liver cancer patients are threatened by the high risk of partial hepatectomies, as the clinical symptoms of liver cancer are not significant in the early stages, and most of the patients have entered the advanced stage when they are diagnosed. Causes of high incidence of complications and mortality [16] include extensive resection and the underlying diseases of hepatitis and cirrhosis in most of the primary liver cancer patients, which greatly affect the prognosis after partial hepatectomy, prolongs the length of the hospital stay, and reduces the utilization rate of medical resources.

First developed by Kehlet in 1997, ERSA has been gradually generalized in the perioperative management of various operations and has been successful [17]. ERSA adopts a series of nursing measures (preoperative health education, intraoperative anesthesia optimization, and postoperative rapid recovery exercise, *etc.*) to reduce the surgical stress and postoperative incidences of complications and mortality, and reduce the metastasis and development of diseases [18]. According to some studies, ERSA can not only significantly accelerate the postoperative recovery, but it can also relieve patients from wound-related inflammation and psychological discomfort due to surgical trauma or disease, thus shortening the length of the hospital stay and reducing the medical expenses [19]. Carter-Brooks et al. performed a Meta-analysis of the effects of ERSA in patients undergoing colorectal surgery and found that the incidence of complications was reduced by 50% [20]. Also, mass clinical data showed that ERSA can achieve significant effects when applied in gastrointestinal and urinary tract operations by re-

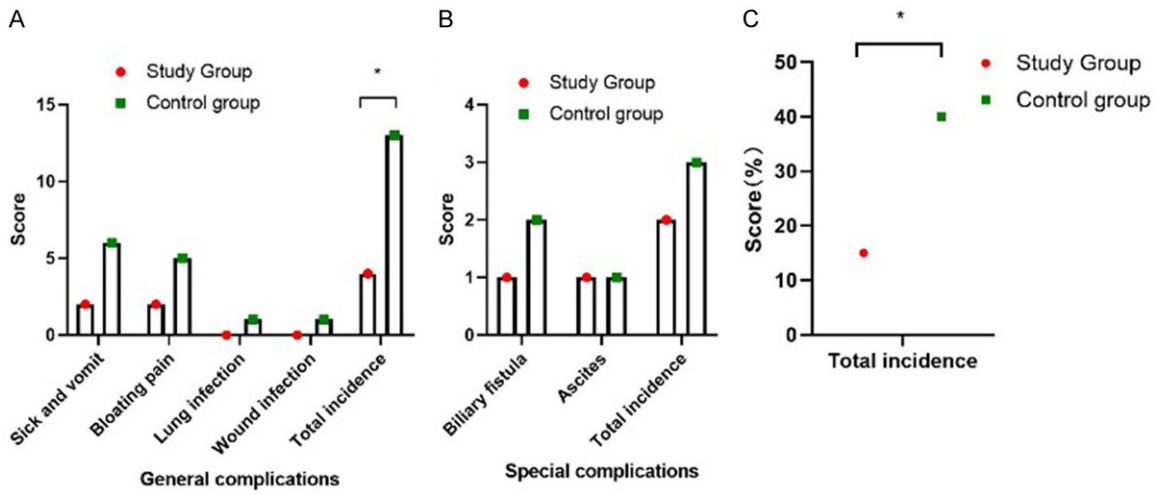

Figure 4. Intergroup comparison of the postoperative complications. The general complications totaled up to 4 in the SG (2 cases of nausea and vomiting, 2 cases of abdominal distension and pain) and 13 (6 cases of nausea and vomiting, 5 cases of abdominal distension and pain, 1 case of pulmonary infection, 1 case of infection of incisional wound) in the CG ($P < 0.05$) (A). Special complications were 2 (1 case of biliary fistula, 1 case of abdominal dropsy) in the SG and 3 (2 cases of biliary fistula, 1 case of abdominal dropsy) in the CG ($P < 0.05$) (B). The total incidence of complications was 15.00% in the SG and 40.00% in the CG ($P < 0.05$) (C); *$P < 0.05$ vs CG.

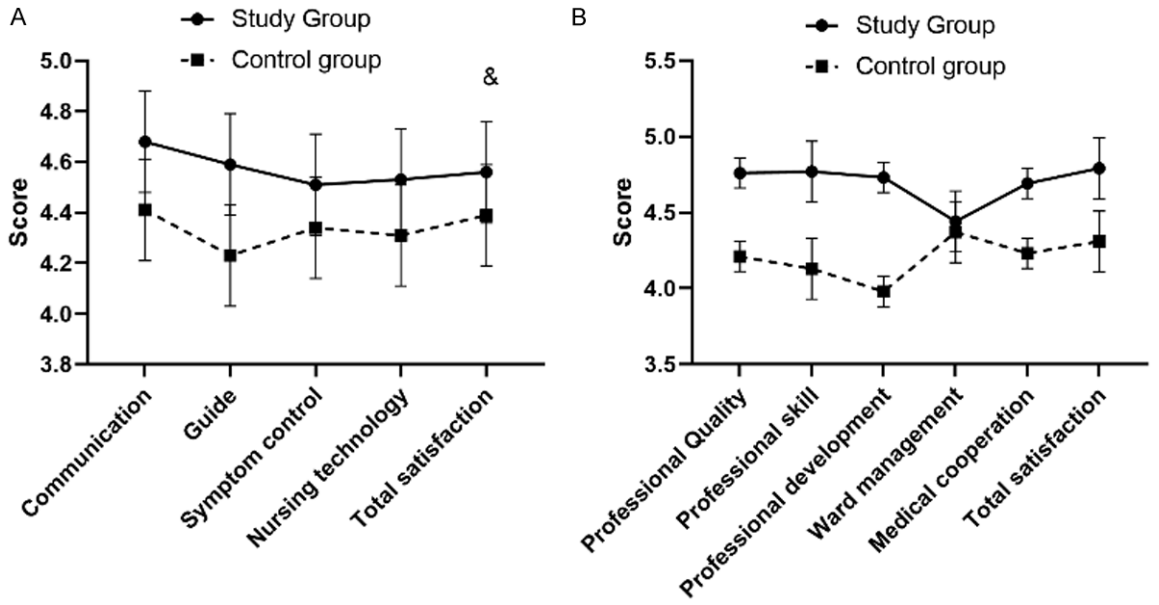

Figure 5. Intergroup comparison of the nursing satisfaction. The patients (A) and physicians (B) in the SG were more satisfied with the nursing than the patients and physicians in the CG ($P < 0.05$); &$P < 0.05$ vs CG.

ducing the readmission rate and demonstrating its effectiveness [21].

By setting up different groups, this study explored the effects of ERSA in the perioperative period of partial hepatectomy patients. According to the results, compared to the CG, SG required shorter times to recover their bowel sounds, realize the first passage of gas through the anus, and to do out-of-bed activities. Also, the lengths of the postoperative hospital stays were shortened, indicating that ERSA played a role in accelerating the postoperative recovery of patients undergoing partial hepatectomy. In this paper, the recovery of intestinal function was taken as the main indi-

cator of postoperative recovery speed. ERSA supports early food intake and basic nutrition support, which have positive effects on improving' the nutrition intake and systematic nutritional status of patients [22]. As a result, the postoperative recovery is accelerated. The postoperative pain intensity and self-care abilities were also compared between the two groups. According to the results, the patients in the SG had significantly lower pain intensity at 12 h, 24 h, and 48 h after surgery and higher self-care abilities at 1 d, 2 d, and 3 d after surgery than patients in the CG, suggesting that ERSA can effectively reduce the postoperative pain intensity of patients and improve their self-care abilities. Some studies have pointed out that partial hepatectomy will result in significant trauma and a large amount of inflammatory algogenic substances in the tissue cells, affecting sleep and activity and prolonging the postoperative recovery process [23]. Using ERSA, the intraoperative body temperature is maintained, central venous pressure is controlled at a low level, liquid management was conducted, and antibiotics were applied. A low body temperature during the surgery will have a significant impact on the postoperative recovery of a patient's functions. According to previous studies, it prolongs the time to metabolize anesthetics, affects thrombin activity and platelet function, and increases the risk of postoperative bleeding. In addition, the postoperative rewarming process will aggravate the stress, increase the incidence of infections of the incisional wounds, and prolong the length of the hospital stay [24]. This point of view has been demonstrated by the low incidence of pulmonary infections and infections of the incisional wound in the SG in this study. The liver is abundantly supplied with blood. Intraoperative bleeding control has always been the key to partial hepatectomy. Controlling the central venous pressure at a low level can significantly reduce the liver venous pressure and about 80% of the blood loss related to hepatectomy. It is feasible and can accelerate the postoperative recovery without any significant renal dysfunction according to previous studies. It is considered in traditional hepatectomy that a high-dose supplement of liquids can ensure the circulation volume, the water-electrolyte balance and the blood perfusion of the main organs during the surgery. However, according to ERSA, this will increase the incidences of abdominal infection and effusion. Moderate doses are proposed to avoid the excessive intake of liquids and electrolytes [25]. The incidence of contamination is high in hepatectomy as the bile duct has to be mutilated, and the preventative application of antibiotics helps reduce the risk of postoperative infections of the incisional wound and improves the prognosis [26]. The complications data reported in this study also demonstrate the high feasibility of this method. Finally, the nursing satisfaction was compared between the two groups, and the reason for the great difference was that ERSA paid more attention to communication and instruction. On the one hand, the patients were motivated and their senses of safety and belongingness were enhanced. On the other hand, an effective communication channel was built for the physicians and nurses to improve the service quality.

In conclusion, ERSA can accelerate the postoperative recovery, reduce the intraoperative pain intensity and the incidence of complications, and improve the self-care abilities of patients and the nursing satisfaction. The defects in this study are as follows: (1) The limited size of the study cohort resulted in insufficiently representative results, (2) The patients were followed up for only a short period of time, which increased the difficulty of evaluating the impact of ERSA on the long-term prognosis after a partial hepatectomy. Therefore, future studies will use larger cohorts over a longer time period to provide a theoretical basis for the accelerated recovery after partial hepatectomy.

Disclosure of conflict of interest

None.

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References

[1] Golob-Schwarzl N, Krassnig S, Toeglhofer AM, Park YN, Gogg-Kamerer M, Vierlinger K, Schröder F, Rhee H, Schicho R, Fickert P and Haybaeck J. New liver cancer biomarkers: PI3K/AKT/mTOR pathway members and eukaryotic translation initiation factors. Eur J Cancer 2017; 83: 56-70.

[2] Ma X, Tan YT, Yang Y, Gao J, Li HL, Zheng W, Lan Q, Rothman N, Shu XO and Xiang YB. Prediagnostic urinary 15-F_{2t}-isoprostane level and liver cancer risk: Results from the Shanghai Women's and Men's Health Studies. Int J Cancer 2018; 143: 1896-1903.
[3] Lou W, Liu J, Gao Y, Zhong G, Ding B, Xu L and Fan W. MicroRNA regulation of liver cancer stem cells. Am J Cancer Res 2018; 8: 1126-1141.
[4] Dhar D, Antonucci L, Nakagawa H, Kim JY, Glitzner E, Caruso S, Shalapour S, Yang L, Valasek MA, Lee S, Minnich K, Seki E, Tuckermann J, Sibilia M, Zucman-Rossi J and Karin M. Liver cancer initiation requires p53 inhibition by CD44-enhanced growth factor signaling. Cancer Cell 2018; 33: 1061-1077, e1066.
[5] Song BH, Ding X, Li C and An GF. Synthesis, crystal structures, and anti-liver cancer activity studies on three similar coordination polymers. Crystals 2018; 8: 207.
[6] Li Q, Zhao Q, Zhang C, Zhang P, Hu A, Zhang L, Schroder PM, Ma Y, Guo Z, Zhu X and He X. The ileal FGF15/19 to hepatic FGFR4 axis regulates liver regeneration after partial hepatectomy in mice. J Physiol Biochem 2018; 74: 247-260.
[7] Barth RJ Jr, Mills JB, Suriawinata AA, Putra J, Tosteson TD, Axelrod D, Freeman R, Whalen GF, LaFemina J, Tarczewski SM and Kinlaw WB. Short-term preoperative diet decreases bleeding after partial hepatectomy: results from a multi-institutional randomized controlled trial. Ann Surg 2019; 269: 48-52.
[8] Chien CS, Chen YH, Chen HL, Wang CP, Wu SH, Ho SL, Huang WC, Yu CH and Chang MH. Cells responsible for liver mass regeneration in rats with 2-acetylaminofluorene/partial hepatectomy injury. J Biomed Sci 2018; 25: 39.
[9] Engelman DT, Ben Ali W, Williams JB, Perrault LP, Reddy VS, Arora RC, Roselli EE, Khoynezhad A, Gerdisch M, Levy JH, Lobdell K, Fletcher N, Kirsch M, Nelson G, Engelman RM, Gregory AJ and Boyle EM. Guidelines for perioperative care in cardiac surgery: enhanced recovery after surgery society recommendations. JAMA Surg 2019; 154: 755-766.
[10] Simpson JC, Bao X and Agarwala A. Pain management in enhanced recovery after surgery (ERAS) protocols. Clin Colon Rectal Surg 2019; 32: 121-128.
[11] McQueen K, Oodit R, Derbew M, Banguti P and Ljungqvist O. Enhanced recovery after surgery for low- and middle-income countries. World J Surg 2018; 42: 950-952.
[12] Currie A, Soop M, Demartines N, Fearon K, Kennedy R and Ljungqvist O. Enhanced recovery after surgery interactive audit system: 10 years' experience with an international web-based clinical and research perioperative care database. Clin Colon Rectal Surg 2019; 32: 75-81.
[13] Meyer LA, Lasala J, Iniesta MD, Nick AM, Munsell MF, Shi Q, Wang XS, Cain KE, Lu KH and Ramirez PT. Effect of an enhanced recovery after surgery program on opioid use and patient-reported outcomes. Obstet Gynecol 2018; 132: 281-290.
[14] Yoshida H, Taniai N, Yoshioka M, Hirakata A, Kawano Y, Shimizu T, Ueda J, Takata H, Nakamura Y and Mamada Y. Current status of laparoscopic hepatectomy. J Nippon Med Sch 2019; 86: 201-206.
[15] Cao J and Chen YJ. Discussion on the approach of laparoscopic hepatectomy. Zhonghua Wai Ke Za Zhi 2019; 57: 503-507.
[16] Kasai M, Cipriani F, Gayet B, Aldrighetti L, Ratti F, Sarmiento JM, Scatton O, Kim KH, Dagher I, Topal B, Primrose J, Nomi T, Fuks D and Abu Hilal M. Laparoscopic versus open major hepatectomy: a systematic review and meta-analysis of individual patient data. Surgery 2018; 163: 985-995.
[17] Rouxel P and Beloeil H. Enhanced recovery after hepatectomy: a systematic review. Anaesth Crit Care Pain Med 2019; 38: 29-34.
[18] Semenkovich TR, Hudson JL, Subramanian M and Kozower BD. Enhanced recovery after surgery (ERAS) in thoracic surgery. Semin Thorac Cardiovasc Surg 2018; 30: 342-349.
[19] Rubinkiewicz M, Witowski J, Su M, Major P and Pędziwiatr M. Enhanced recovery after surgery (ERAS) programs for esophagectomy. J Thorac Dis 2019; 11: S685-S691.
[20] Carter-Brooks CM, Du AL, Ruppert KM, Romanova AL and Zyczynski HM. Implementation of a urogynecology-specific enhanced recovery after surgery (ERAS) pathway. Am J Obstet Gynecol 2018; 219: 495.e1-495.e10.
[21] Teigen NC, Sahasrabudhe N, Doulaveris G, Xie X, Negassa A, Bernstein J and Bernstein PS. Enhanced recovery after surgery at cesarean delivery to reduce postoperative length of stay: a randomized controlled trial. Am J Obstet Gynecol 2020; 222: 372.e1-372.e10.
[22] Liu F, Wang W, Wang C and Peng X. Enhanced recovery after surgery (ERAS) programs for esophagectomy protocol for a systematic review and meta-analysis. Medicine (Baltimore) 2018; 97: e0016.
[23] Mendivil AA, Busch JR, Richards DC, Vittori H and Goldstein BH. The impact of an enhanced recovery after surgery program on patients treated for gynecologic cancer in the community hospital setting. Int J Gynecol Cancer 2018; 28: 581-585.
[24] Smith TW Jr, Wang X, Singer MA, Godellas CV and Vaince FT. Enhanced recovery after sur-

gery: a clinical review of implementation across multiple surgical subspecialties. Am J Surg 2020; 219: 530-534.

[25] Greer N, Sultan S, Shaukat A, Dahm P, Lee A, MacDonald R, McKenzie L and Ercan-Fang D. VA evidence-based synthesis program reports. Enhanced recovery after surgery (ERAS) programs for patients undergoing colorectal surgery. Washington (DC): Department of veterans affairs (US); 2017.

[26] Agarwal V and Divatia JV. Enhanced recovery after surgery in liver resection: current concepts and controversies. Korean J Anesthesiol 2019; 72: 119-129.