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Original Article

Effect of rapid rehabilitation nursing on inflammation and liver function after laparoscopic radical resection of primary liver cancer

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Abstract: Objective: To explore the effect of rapid rehabilitation nursing on inflammation and liver function in patients with primary liver cancer (PLC) after laparoscopic radical resection. Methods: A total of 124 PLC patients who underwent laparoscopic radical surgery in the Zhuji People's Hospital of Zhejiang Province from April 2019 to July 2021 were enrolled in this retrospective study. Among them, 65 patients who received rapid rehabilitation nursing were assigned into the observation group (OG), and the other 59 with routine nursing were considered to be the control group (CG). The pain before operation (T0), 3 days after operation (T1) and 7 days after operation (T2) was evaluated by visual analogue scale (VAS). The perioperative related indexes and nursing satisfaction were compared. The levels of liver function indexes alanine aminotransferase (ALT), aspartate aminotransferase (AST), total bilirubin (TBIL) and inflammatory factors C-reactive protein (CRP), interleukin-6 (IL-6) and tumor necrosis factor-α (TNF-α) were measured before operation, 1 day and 7 days after operation. Finally, the incidence of postoperative complications was counted, the 6-month survival rate of both groups of patients was compared. Results: There was no obvious difference in VAS scores between the two groups at T0 ($P>0.050$), but the VAS scores at T1 and T2 in the OG were lower than those in the CG ($P<0.001$). There was no marked difference in the total operation time. Compared with the CG, the time to first exhaust, catheter indwelling and hospitalization in the OG were shorter ($P<0.001$) and the nursing satisfaction rate was higher ($P<0.05$). There was no obvious difference in ALT, AST and TBIL on the 1st day after operation ($P>0.05$); however, on the 7th day after operation, ALT and AST were lower while TBIL was higher in the OG (all $P<0.05$). There was no marked difference in CRP, IL-6 and TNF-α between the two groups on postoperative day 1 ($P>0.05$), but the levels were lower in the OG than those in the CG on postoperative day 7 (all $P<0.05$), and the total incidence of adverse reactions in the OG was lower ($P<0.05$). There was no statistical difference in the postoperative survival rate between both groups of patients ($P>0.05$). Age, number of lesions, tumor size, Child-Pugh grade, AST, TBIL, CRP, IL-6, TNF-α were associated with the survival rate of patients. Conclusion: Rapid rehabilitation nursing can effectively reduce adverse reactions after laparoscopic radical resection of PLC. Thus, it has a high application value in future clinical treatment.

Keywords: Laparoscopic radical resection of primary liver cancer, rapid rehabilitation nursing, inflammation, liver function, inflammation

Introduction

Primary liver cancer (PLC) is the main type of liver cancer (LC) [1]. Due to poor prognosis, high incidence of postoperative recurrence, PLC and liver metastasis are still the main cause of cancer-related death, especially in China [2, 3]. The incidence of LC in China is higher than the world average. China currently accounts for more than half of the world's new PLC patients and ranks third in tumor-related mortality, with a rate of 26 per 100,000 people [4]. Hepatitis B virus, hepatitis C virus and other toxin infections as well as excessive drinking may lead to the occurrence and development of PLC [5, 6].

The most effective and curable treatment for PLC is radical resection [7]. However, hepatectomy will damage the liver function of patients to varying degrees, and oxidative stress during the operation may also have an adverse effect on liver function [8].

Laparoscopic hepatectomy, as a minimally invasive operation, has less trauma and has gradu-

ally become the standard surgical practice [9]. In addition, it has been gradually accepted because of its safety, feasibility and good short- and long-term outcomes [10]. Some studies have shown that the postoperative recovery of PLC patients undergoing laparoscopic radical surgery is quite different, so it's necessary to explore better nursing models to improve the postoperative recovery of PLC patients [11].

As a key means to ensure the success of operation, reduce postoperative complications and promote the rehabilitation of patients, rapid rehabilitation nursing has been frequently used in orthopedics, cardiothoracic, breast and gastrointestinal surgeries [12]. Through perioperative nutritional support and fluid management, emphasis on oxygen supply, early feeding, and minimally invasive surgery, personalized nursing programs are developed for patients according to their own conditions and actual surgical indicators [12].

In this study, we compared the nursing effects of a rapid rehabilitation nursing model and the conventional nursing model in PLC patients who underwent laparoscopic radical resection of cancer, in order to provide clinical reference for the nursing of this type of population.

Materials and methods

Patient data

A total of 124 patients with PLC who underwent laparoscopic radical surgery in the Zhuji People's Hospital of Zhejiang Province from April 2019 to July 2021 were enrolled in this retrospective study. Among them, 65 patients who received rapid rehabilitation nursing were regarded as the observation group (OG), including 34 males and 31 females, with an average age of (49.3±9.3) years. The other 59 patients undergoing routine nursing were considered as the control group (CG), including 36 males and 23 females, with an average age of (50.8±9.6) years. This study was approved by the Ethics Committee of Zhuji People's Hospital of Zhejiang Province (approval No.: 20220420) with consent obtained from the patients or their family members.

Inclusion and exclusion criteria

Inclusion criteria: Patients diagnosed with PLC [13] by imaging and pathology; Patients who conformed to the indications of laparoscopic radical surgery; Patients with complete clinical data; Patients with follow-up data.

Exclusion criteria: Patients who were not willing to receive laparoscopic radical surgery; Patients with surgical contraindications; Patients with unconsciousness or cognitive impairment; Patients with severe immunodeficiency, severe infections or inflammatory diseases before operation; Patients with congenital defects in liver, kidney and heart; or Patients with an estimated survival time less than 6 months.

Nursing mode

The routine nursing program was carried out for patients in the CG. 1. Preoperative nursing: The nurses introduced PLC and laparoscopic radical hepatectomy to patients and their families, so that they could understand the disease and treatment to reduce stress before operation. 2. Postoperative nursing: The nurses carefully observed the wound condition and took good care of surgical wounds and tube drainage. Attention was also paid to the patency of the respiratory tract in real time. In addition, oral care, balanced diet and information and guidance on medication were introduced to patients. 3. Complication nursing: We explained possible complications to patients, actively observed patients' condition and complications, and communicated with the doctors immediately to take proper interventions.

The rapid rehabilitation nursing program was carried out for patients in the OG. 1. Psychological nursing: The nurses paid close attention to the psychological changes of patients and publicized successful rehabilitation cases to patients to eliminate their negative emotions such as anxiety, fear and tension and improve their confidence. Moreover, the etiology, treatment, efficacy and prognosis of the disease were introduced to the patients and their family members. 2. Preoperative preparation: We timely evaluated patients' physical condition, to predicted and deal with possible complications, we examined the function of important organs, such as ECG, liver function, bleeding and clotting time, prothrombin determination and fibrinolytic activity, etc. The gastrointestinal tract was prepared. The training for being bedridden including defecation and urination was carried out, with a digestible semi-fluid diet given the day before operation, and the gastric

tube and urinary catheter were indwelled before operation. 3. Intraoperative nursing: A sufficient amount of blood was prepared in advance; various indicators during the operation were closely monitored, and proper measures were taken in time in case of any abnormality. 4. Postoperative nursing: The nurses took good care of the surgical wound and drainage tube after operation. The postoperative functional exercise was formulated, guided and supervised by professional rehabilitation specialists. A scientific, balanced and nutritious diet was suggested, mainly based on a light and digestible diet under the conditions of meeting the energy needs. 5. Nursing of complications: Patients were in the semi-recumbent position, given oxygen inhalation or ventilator-assisted oxygen inhalation; vital indicators such as blood oxygen saturation, pulse, complexion and heart rate were closely monitored. The nurses paid attention to abdominal incisions and the drainage tube after operation, as well as wound hygiene etc.; The adverse reactions were dealt with in real time. 6. Pain care: The pain of patients was relieved by music/video, massage or analgesics according to their pain intensity.

Follow up methods

All patients were followed up for six months after the operation by telephone and outpatient reexamination. Follow-up was conducted every three months to determine the survival of the patients.

Outcome measures

(1) Pain before operation (T0), 3 days after operation (T1) and 7 days after operation (T2) was assessed via visual analogue scale (VAS) with a range of 0-10. Aero corresponded to no pain, and 10 corresponded to server pain. The higher the score, the stronger the pain. (2) The venous blood (5 mL) of patients was taken before operation, at 1 day and 7 days after operation and centrifuged at 3000 r/min to assess the level of liver function indexes, alanine aminotransferase (ALT), aspartate aminotransferase (AST), total bilirubin (TBIL) and inflammatory factor indexes, C-reactive protein (CRP), interleukin-6 (IL-6) and tumor necrosis factor-α (TNF-α). The levels of AST, ALT and TBIL were tested by automatic biochemical analyzer (Hitachi 7180), and CRP, IL-6 and TNF-α were assessed by ELISA method (R&D Systems, DCRP00, D6050, DTA00D). (3) The nursing satisfaction of patients was investigated by self-made nursing satisfaction questionnaire [14]. (4) The postoperative complications of both groups were counted and compared. (5) The survival conditions of both groups at 6 months after operation were statistically analyzed.

Statistical methods

SPSS 20.0 software (Chicago SPSS Co., Ltd.) was used for statistical analysis. Continuous variables were expressed by mean ± standard deviation, and the inter-group comparison and intra-group comparison were conducted using independent t-test and paired t-test, respectively. Classification variables were represented as number or percentage, and analyzed using chi-square analysis. Repeated measures analysis of variance (ANOVA) was used for comparison among three or more groups, with Bonferroni test for the post hoc test. Patients' survival was analyzed using K-M survival analysis. $P<0.05$ was regarded as statistically marked significant.

Results

Patient baseline data

There were no marked differences in gender, age, BMI, ASA grade, type, operation site, number of lesions, tumor size or Child-Pugh grade between the two groups, indicating the groups were comparable (**Table 1**).

VAS score of both groups

There was no significant difference in preoperative VAS score between the two groups ($P>0.05$). The VAS score increased dramatically in both groups on the 3rd day after operation and then decreased gradually; however, the VAS scores at T1 and T2 in the OG were markedly lower than those in the CG ($P<0.05$) (**Table 2**).

Effects of different nursing methods on patients during the perioperative period

There was no significant difference in operation time between the two groups ($P>0.05$). However, the time to first exhaust, catheter indwelling and hospitalization in the OG were significantly shorter than those in the CG (all $P<0.05$) (**Figure 1**).

Table 1. Baseline data of the two groups

	Observation group (n=65)	Control group (n=59)	X^2/t	P
Gender			0.954	0.329
Male	34 (52.31)	36 (61.02)		
Female	31 (47.69)	23 (38.98)		
Age (year)	49.3±9.3	50.8±9.6	0.883	0.379
BMI (Kg/m^2)	21.36±1.57	21.14±1.27	0.853	0.396
ASA classification			1.509	0.131
I	20 (30.77)	12 (20.34)		
II	32 (49.23)	30 (50.85)		
III	13 (20.00)	17 (28.81)		
Type			0.267	0.875
Hepatocellular carcinoma (HCC)	35 (53.85)	34 (57.63)		
Cholangiocarcinoma	23 (35.38)	20 (33.90)		
Others	7 (10.77)	5 (8.47)		
Surgical site			1.438	0.231
Right hemihepatectomy	25 (38.46)	29 (49.15)		
Left hemihepatectomy	40 (61.54)	30 (50.85)		
Number of lesions			0.353	0.552
≤2	34 (52.31)	34 (57.63)		
>2	31 (47.69)	25 (42.37)		
Tumor size (cm)			0.196	0.658
≤2	36 (55.38)	35 (59.32)		
>2	29 (44.62)	24 (40.68)		
Child-pugh grade			0.584	0.445
Grade A	48 (73.85)	47 (79.66)		
Grade B	17 (26.15)	12 (20.34)		

Note: BMI, body mass index.

Table 2. VAS score of patients in the two groups

	T0	T1	T2
Observation group (n=65)	0.40±0.13	2.74±0.58^A	1.84±0.33^{A,B}
Control group (n=59)	0.44±0.15	3.27±0.64^A	2.42±0.41^{A,B}
T	0.114	4.838	8.713
P	1.590	<0.001	<0.001

Note: ^{A}compared with T0 (P<0.05); ^{B}compared with T1 (P<0.05). VAS, visual analogue scale.

Effects of different nursing methods on liver function of patients

The ALT and AST of both groups on the 1st day after operation were higher than those before operation (P<0.05), and the TBIL on the 1st day after operation was lower than that before operation (P<0.05). There was no marked difference in ALT, AST and TBIL on the 1st day after operation between the two groups (all P>0.05). The ALT and AST of both groups on the 7th day after operation were lower than those on the 1st day after operation (P<0.05), with significantly lower levels in OG as compares with CG (all P<0.05). The TBIL at 7 days after operation was higher than that at 1 day after operation (P<0.05), with significantly lower levels in OG as compared with the CG (P<0.05) (**Figure 2**).

Effect of different nursing methods on inflammation of patients

The CRP, IL-6 and TNF-α levels on the first day after operation in both groups were slightly higher than those before operation (all P>0.05). The CRP, IL-6 and TNF-α levels on postoperative day 7 in both groups were significantly lower than those at postoperative day 1 (P<0.05), and those in the OG were significantly lower than those in the CG (all P<0.05) (**Figure 3**).

Effects of different nursing methods on postoperative complications

The major complications in the OG were bleeding, pleural effusion, fever and diarrhea, while the complications in the CG were hemorrhage, pleural effusion, fever, diarrhea and pulmonary infection. The total incidence of adverse reactions in the OG was significantly lower than that in the CG (P<0.05) (**Table 3**).

Comparison of nursing satisfaction

According to the survey, 6 patients in the CG were dissatisfied, 7 felt the care was fair, 28 were satisfied, and 18 were very satisfied, with

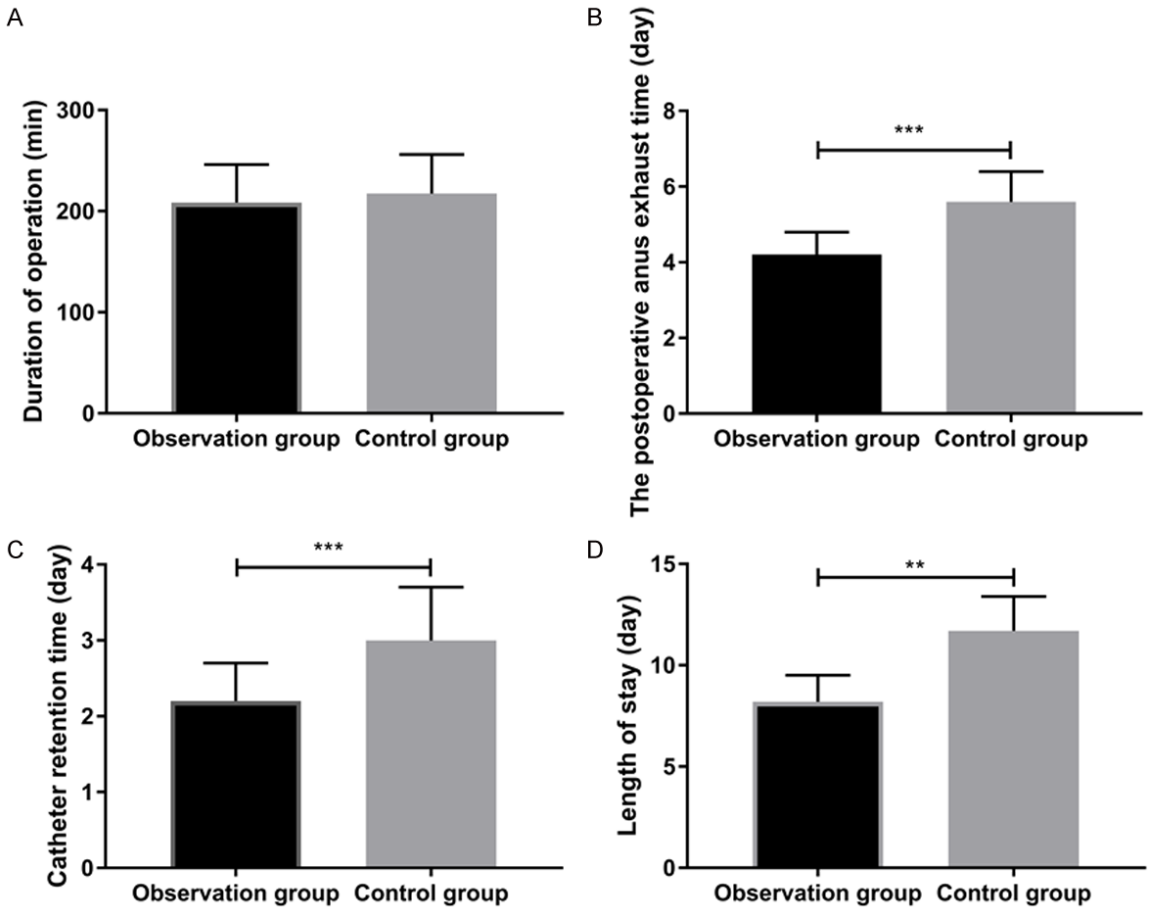

Figure 1. Influence of different nursing methods on patients during perioperative period. A. There was no marked difference in the total operation time between the two groups (P>0.05). B. The first exhaust time of the observation group (OG) was earlier than that of the control group (CG) (P<0.05). C. The indwelling time of catheter in the OG was less than that in the CG (P<0.05). D. The time of hospitalization in the OG was less than that in the CG (P<0.05). Note: **, P<0.01; ***, P<0.001.

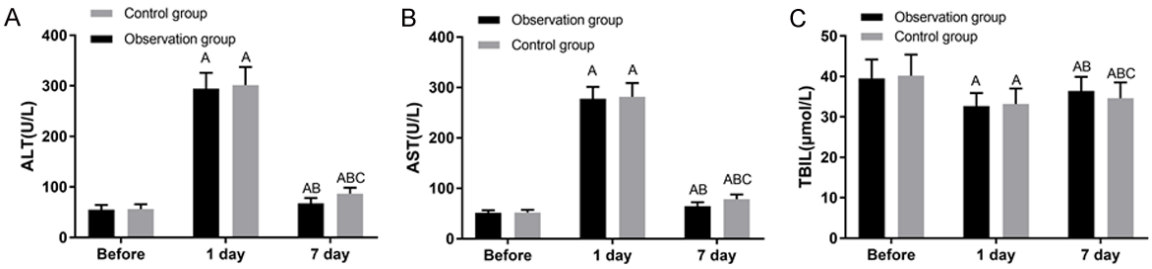

Figure 2. Effect of different nursing methods on patients' liver function. A. The ALT of both groups on the 1st day after operation was higher than that before operation (P<0.05), but there is no marked difference between groups (P<0.05). On the 7th day after operation, the ALT was lower than that on the 1st day after operation, and the ALT in the OG was lower than that in the CG (P<0.05). B. The AST of both groups on the 1st day after operation was higher than that before operation (P<0.05), but there was no marked difference between groups (P<0.05). On the 7th day after operation, the AST of both groups was lower than that on the 1st day after operation, and the AST in the OG was lower than that in the CG (P<0.05). C. The TBIL of both groups on the 1st day after operation was lower than that before operation (P<0.05), but there was no marked difference between groups (P<0.05). On the 7th day after operation, the TBIL of both groups was higher than that on the 1st day after operation, and the TBIL in the OG was higher than that in the CG (P<0.05).

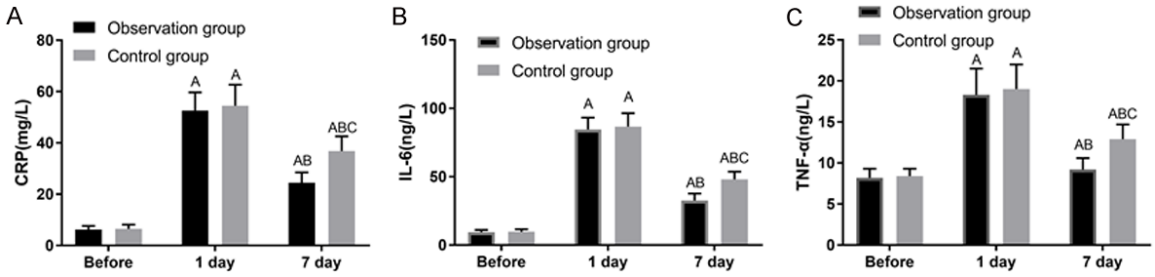

Figure 3. Effect of different nursing methods on the inflammation of patients. A-C. The levels of inflammatory factors CRP, IL-6 and TNF-α increased after operation (P<0.05). Rapid rehabilitation nursing reduced the level of inflammation more quickly, and the level in the OG was lower than that in the CG 7 days after operation (P<0.05). Note: A, compared with day 1 (P<0.05), B, compared with day 7 (P<0.05), and C, compared with the observation group (P<0.05).

Table 3. Occurrence of complications

	Observation group (n=65)	Control group (n=59)	X^2	P
Bleeding	1 (1.54)	3 (5.08)		
Pleural effusion	1 (1.54)	1 (1.69)		
Fever	1 (1.54)	4 (6.78)		
Diarrhea	2 (3.08)	5 (8.47)		
pulmonary infection	0 (0.00)	1 (1.69)		
Total adverse reactions	5 (7.69)	14 (23.73)	6.130	0.013

Table 4. Nursing satisfaction rate in the two groups

	Observation group (n=65)	Control group (n=59)	X^2	P
Dissatisfied	2 (3.08)	6 (10.17)		
Fair	3 (4.62)	7 (11.86)		
Satisfied	22 (33.85)	28 (47.46)		
Very satisfied	38 (58.46)	18 (30.51)		
Total satisfaction	60 (92.31)	46 (77.97)	5.126	0.024

an overall nursing satisfaction rate of 77.97%. In the OG, 2 patients were not satisfied with nursing, 3 thought it was fair, 22 were satisfied, 38 were very satisfied, and the overall nursing satisfaction rate was 92.31%. This revealed that the nursing satisfaction rate of patients in the OG was higher than that in the CG (P<0.05) (**Table 4**).

Comparison of postoperative survival

The 6-month survival of patients in both groups was counted. Four patients died in the observation group 6 months after the operation, and the overall survival rate was 93.85%. In the control group, 5 patients died 6 months later, and the overall survival rate was 91.53%. The K-M curve showed that there was no statistical difference in 6-month survival rate between the two groups (P>0.05) (**Figure 4**).

Analysis of factors affecting patients' survival

According to the survival of patients in the two groups, they were divided into the survival group (n=115) and the death group (n=9). The clinical data of patients in the two groups were collected. It was found that the age, number of lesions, tumor size, Child-Pugh grade, AST, TBIL, CRP, IL-6, TNF-α of patients in the two groups were related to the survival of patients (**Table 5**).

Discussion

Early PLC is curable after radical resection of the LC tissue. Although minimally invasive techniques provide less trauma, patients still experience pain and adverse effects [15, 16]. Therefore, it's necessary to conduct effective nursing to ease their suffering.

Routine care is often based on the doctor's judgment and advice of patients, so it is not standardized [17]. To help patients recover better, reduce the complications and mortality, and shorten the days of treatment, rapid rehabilitation nursing with comprehensive multidisciplinary measures is used in the perioperative period to improve the nursing efficacy in many surgical scenarios [18, 19]. The liver is abnormally rich in hepatic vessels, thus, laparoscopic

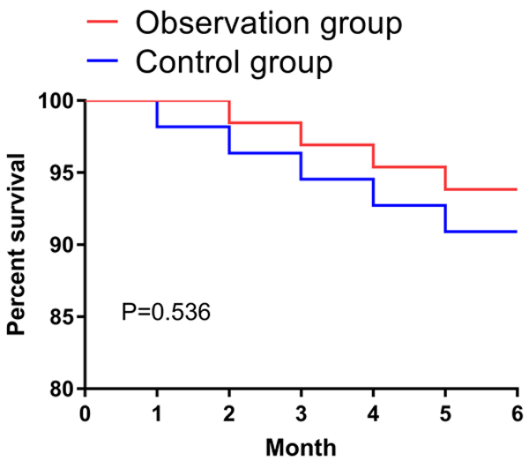

Figure 4. Comparison of survival rate between the two groups. There was no significant difference in the 6-month survival rate between the two groups (P=0.536).

surgery, despite its minimal invasive operation with a small incision [20], can still lead to severe visceral pain in deep tissues, while carbon dioxide in the pneumoperitoneum may also stimulate the intestinal and systemic nerves, aggravating the surgical trauma and pain intensity. In our study, we found that the VAS score on postoperative day 3 & 7 of patients received rapid rehabilitation nursing were lower than those in the CG, indicating that rapid rehabilitation nursing has a better effect on pain management. Besides, the time to first exhaust, catheter indwelling time and hospitalization time of the rapid rehabilitation nursing group were shorter than those in the conventional nursing group, suggesting that rapid rehabilitation nursing can provide patients with better postoperative recovery.

Patients undergoing hepatectomy are prone to postoperative stress due to surgical trauma, which can damage the liver function of patients, induce inflammation, and increase the level of inflammatory factors and the risk of postoperative complications [21, 22]. Our study found that patients in the rapid rehabilitation nursing group had a better recovery in postoperative liver function indices ALT, AST, TBIL and a more rapid reduction in inflammatory factors CRP, IL-6, and TNF-α. The reason may be that rapid rehabilitation nursing enabled patients to be well-prepared before operation to enhance their ability to tolerate the surgery. Postoperative complications such as abdominal distension and incision infection easily occur in LC patients, and rapid rehabilitation nursing can effectively reduce the occurrence of complications [23]. This research revealed that the incidence of postoperative complications in the OG was 7.69%, which was lower than 23.73% in the CG. Although the intervention of routine nursing can improve the postoperative recovery ability of patients to some extent, there are still some shortcomings. Patients often have a certain degree of psychological burden after diagnosis and operation, which is difficult to be eliminated by conventional nursing methods, while rapid rehabilitation surgical nursing has psychological nursing intervention, which can better improve patients' psychological condition and improve their confidence in treatment [24]. Thus, if we enlighten patients in time, and are prepared to prevent complications before the operation to reduce their incidence, and effectively deal with the complications in real time after operation, the quality of life of patients will be improved [25]. In the end, we discovered that the total satisfaction rate in the rapid rehabilitation nursing group was 92.31%, which was higher than that in the routine nursing group (77.97%). This may be due to the fact that the negative emotions of patients were improved by the psychological care and intervention, thus making them feel more confident and delighted with the attention and care. Wang et al. [26] confirmed that patients undergoing gastrectomy were given rapid rehabilitation nursing, and marked improvements in pain and complications were found, and satisfaction with nursing was higher than in those receiving routine perioperative nursing, which is similar to our results. The 6-month survival rate between both groups was observed, and no significant difference was found.

Nevertheless, there are also some limitations. First of all, we didn't further study the differences in nursing outcomes among patients with other treatments for LC. Secondly, this research did not explore other related factors of complications in patients undergoing laparoscopic radical hepatectomy. Finally, the impact of rapid rehabilitation nursing on the long-term prognosis of patients is still to be explored. We hope to further explore these issues in the follow-up research to solidify our findings.

To sum up, rapid rehabilitation nursing can effectively reduce the adverse reactions after

Table 5. Analysis of factors affecting patients' survival

	Survival group (n=115)	Death group (n=9)	X^2/t	P
Gender			2.110	0.146
Male	67 (58.26)	3 (33.33)		
Female	48 (41.74)	6 (66.67)		
Age (year)	48.5±7.8	69.7±4.7	8.022	<0.001
BMI (Kg/m^2)	21.27±1.43	21.08±1.59	0.381	0.704
ASA classification			4.209	0.122
I	32 (27.83)	0 (0.00)		
II	57 (49.56)	5 (55.56)		
III	26 (22.61)	4 (44.44)		
Type			1.802	0.406
Hepatocellular carcinoma (HCC)	65 (56.52)	4 (44.44)		
Cholangiocarcinoma	40 (34.78)	3 (33.33)		
Others	10 (8.70)	2 (22.22)		
Surgical site			0.569	0.451
Right hemihepatectomy	49 (42.61)	5 (55.56)		
Left hemihepatectomy	66 (57.39)	4 (44.44)		
Number of lesions			4.958	0.026
≤2	57 (49.57)	1 (11.11)		
>2	58 (50.43)	8 (88.89)		
Tumor size (cm)			13.000	<0.001
≤2	71 (61.74)	0 (0.00)		
>2	44 (38.26)	9 (100.00)		
Child-Pugh grade			3.185	0.001
Grade A	92 (80.00)	3 (33.33)		
Grade B	23 (20.00)	6 (66.67)		
Nursing mode			0.248	0.619
rapid rehabilitation nursing	61 (53.04)	4 (44.44)		
routine nursing	54 (46.96)	5 (55.56)		
ALT (U/L)	55.43±9.31	57.84±12.20	0.731	0.466
AST (U/L)	51.34±9.31	58.21±3.53	2.194	0.030
TBIL (μmol/L)	39.47±4.87	44.01±3.95	2.724	0.007
CRP (mg/L)	6.15±1.36	8.90±0.66	5.994	<0.001
IL-6 (ng/L)	9.36±1.57	12.07±1.51	5.000	<0.001
TNF-α (ng/L)	8.14±0.94	8.93±1.05	2.409	0.018

Note: BMI, body mass index; ALT, alanine aminotransferase; AST, aspartate aminotransferase; TBIL, total bilirubin; CRP, C-reactive protein; IL-6, interleukin-6; TNF-α, tumor necrosis factor-α.

laparoscopic radical resection of PLC and provide more reliable protection for patients' liver function. It has high application value in future clinical treatment.

Disclosure of conflict of interest

None.

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