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Effect of Laparoscopic Radical Resection and Open Surgery for Liver Cancer and Their Impact on Inflammatory Factor Levels

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Abstract: *Objective*: To evaluate the therapeutic effects of laparoscopic radical resection and open surgery for liver cancer. *Methods*: A total of 80 liver cancer patients admitted to the hospital from January 2023 to January 2025 were selected and equally divided by a random number table. The observation group underwent laparoscopic radical resection, while the reference group underwent open surgery. Perioperative indicators and inflammatory factor levels were compared between the two groups. *Results*: The observation group exhibited superior perioperative indicators. One day after surgery, the observation group showed excellent inflammatory factor levels, lower fibrosis factor levels, excellent liver function indicators, and a reduced complication rate, with a statistically significant difference between the groups ($P < 0.05$). *Conclusion*: Laparoscopic radical resection for liver cancer is minimally invasive, promotes postoperative recovery, reduces postoperative inflammatory responses, inhibits the progression of liver fibrosis, protects liver function, and demonstrates high surgical safety.

Keywords: Laparoscopic radical resection for liver cancer; Open surgery; Liver cancer; Inflammatory factor levels

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1. Introduction

Liver cancer is a gastrointestinal tumor with a relatively high incidence rate. It lacks typical symptoms in the early stages of the disease, has strong concealment, and is mostly diagnosed in the middle to late stages, making surgical treatment challenging [1]. Open surgery is a commonly used curative treatment for this disease, allowing for the resection of liver cancer lesions under direct vision. The surgical procedure is relatively simple, but the precision of the operation is not optimal, which can easily lead to adverse events such as intraoperative bleeding, thereby affecting the quality of the surgery. In comparison, laparoscopic surgery offers significant minimally invasive advantages, reducing intraoperative blood loss, avoiding risk factors for postoperative complications, shortening the patient's rehabilitation period, and achieving better surgical prognosis [2]. Based on this, this study selected 80 patients with liver cancer to evaluate the therapeutic advantages of laparoscopic radical resection of liver cancer for patients with this disease.

2. Materials and methods

2.1. General information

Eighty patients with liver cancer admitted to the hospital from January 2023 to January 2025 were included and equally divided using a random number table. The observation group consisted of 40 patients, including 22 males and 18 females; their ages ranged from 40 to 74 years, with a mean age of (55.16 ± 4.78) years old; the tumor diameters ranged from 1.5 to 7.1 cm, with a mean diameter of (4.12 ± 0.59) cm; in terms of TNM staging, 19 cases were stage I and 21 cases were stage II. The reference group consisted of 40 patients, including 24 males and 16 females; their ages ranged from 41 to 76 years, with a mean age of (55.27 ± 4.62) years old; the tumor diameters ranged from 1.6 to 7.3 cm, with a mean diameter of (4.19 ± 0.63) cm; in terms of TNM staging, 17 cases were stage I and 23 cases were stage II. When comparing the data between the two groups, $P > 0.05$.

Inclusion criteria: Diagnosed with liver cancer according to the “Diagnostic and Treatment Guidelines for Primary Liver Cancer (2017 Edition)” [3]; pathological diagnosis of liver cancer; meeting surgical indications; having relatively complete basic information; highly informed about the study. Exclusion criteria: Presence of cardiopulmonary, hepatic, or renal dysfunction; intrahepatic or distant metastasis of tumor lesions; suffering from other malignant tumors; having surgical contraindications; significant fluctuations in vital signs; withdrawing from the study midway.

2.2. Methods

The reference group underwent laparotomy: The patient was assisted to assume a supine position with the body in a “humanoid” shape, and tracheal intubation and general anesthesia were performed. Based on the location of the tumor lesion, the incision was made at the right subcostal margin or the midline of the abdomen. The abdominal cavity was entered through the incision, and the ligaments around the liver parenchyma were dissected to expose the tumor lesion. The liver parenchyma was separated using an ultrasonic scalpel, and the tumor lesion was completely resected, with attention paid to controlling intraoperative bleeding. Evaluate for the presence of bile leakage. If no abnormalities were found, a drainage tube was placed, and the abdomen was closed routinely.

The observation group underwent laparoscopic radical resection of liver cancer: The position and anesthesia method were the same as above. The observation port was located 1 cm below the umbilicus, and a 10 mm trocar was inserted; the operating ports were located at the anterior axillary line below the xiphoid process, the subcostal region, and the midline of the left and right clavicles, with 5 mm trocars inserted to create a pneumoperitoneum with a pressure value of 8–12 mmHg. A comprehensive exploration of the patient’s abdominal cavity should be conducted, and the choice of radical resection method should be differentiated based on tumor staging. If the tumor is located in segments II to III, a left lateral lobectomy should be performed under laparoscopic guidance, and a linear stapler should be used during the process of transecting the liver parenchyma. If the tumor is located in segment IV or is a large-volume tumor, a left hemihepatectomy should be performed under laparoscopic guidance. The resection margin line should be determined using laparoscopic ultrasound, the liver parenchyma should be separated, hemostasis should be achieved by electrocoagulation, the left hepatic pedicle should be transected using a linear stapler, the left hepatic vein and residual liver tissue should be fully resected, and the left hemihepatectomy should be completed. If the tumor is located in segments V to VIII, a partial hepatectomy should be performed based on the tumor diameter.

2.3. Observation indicators

(1) Perioperative indicators: Evaluate indicators such as incision length, intraoperative blood loss, and postoperative time to initiate a liquid diet.

(2) Level of inflammatory factors: Venous blood (5ml, fasting) should be collected before surgery and on postoperative day 1, centrifuged for 10 minutes at a speed of 3500 r/min, and the supernatant should be taken to evaluate interleukin-6 (IL-6), IL-2, and tumor necrosis factor-α (TNF-α) using enzyme-linked immunosorbent assay.

(3) Fibrosis factors: At the same time intervals, blood should be collected, centrifuged, and the supernatant taken to evaluate hyaluronic acid (HA), procollagen type III peptide (PIIIP), and procollagen type I carboxy-terminal peptide (PICP) using an automated enzyme-linked immunosorbent assay reader with an immunoluminescence method.

(4) Liver function indicators: At the same time period, after blood collection, a fully automated biochemical analyzer was used to evaluate aspartate aminotransferase (AST), total bilirubin (TBil), and alanine aminotransferase (ALT).

(5) Complication rate: Observe the incidence probabilities of refractory ascites, abdominal cavity infection, encapsulated effusion in the liver section, and other conditions.

2.4. Statistical analysis

Data were processed using SPSS 28.0 software. Measurement values were compared/tested using t-values, while count values were compared/tested using chi-square (χ^2) values. Statistical significance was considered as $P < 0.05$.

3. Results

3.1. Comparison of perioperative indicators between groups

The perioperative indicators in the observation group were superior to those in the reference group ($P < 0.05$) (**Table 1**).

Table 1. Comparison of perioperative indicators between groups (mean ± SD)

Group	Number of cases (*n*)	Incision length (cm)	Intraoperative blood loss (mL)	Time to liquid diet postop (days)	Time to ambulation postop (days)	Postoperative hospital stay (days)
Observation Group	40	6.35 ± 1.48	198.75 ± 16.45	4.27 ± 1.51	1.44 ± 0.52	12.45 ± 2.66
Control Group	40	22.16 ± 3.18	271.36 ± 22.71	6.62 ± 1.78	2.81 ± 0.75	15.37 ± 2.74
t-value	-	28.508	16.376	6.367	9.494	4.836
P-value	-	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001

3.2. Comparison of inflammatory factor level between groups

One day after surgery, the inflammatory factor levels in the observation group were excellent, with a significant difference between groups ($P < 0.05$) (**Table 2**).

Table 2. Comparison of inflammatory factor level between groups (mean ± SD)

Group	Number of cases (*n*)	IL-6 (pg/mL)		IL-2 (μg/L)		TNF-α (ng/mL)	
		Preop	Postop 1d	Preop	Postop 1d	Preop	Postop 1d
Observation Group	40	9.45 ± 1.78	11.12 ± 2.19	5.30 ± 1.06	4.47 ± 1.05	3.29 ± 0.57	4.22 ± 0.78
Control Group	40	9.41 ± 1.82	13.37 ± 2.25	5.29 ± 1.10	3.43 ± 0.86	3.32 ± 0.63	5.91 ± 1.78
t-value	-	0.099	4.532	0.041	4.846	0.223	5.500
P-value	-	0.921	< 0.001	0.967	< 0.001	0.824	< 0.001

3.3. Comparison of fibrosis factors between groups

One day after surgery, the fibrosis factors in the observation group were lower, with a significant difference between groups ($P < 0.05$) (**Table 3**).

Table 3. Comparison of fibrosis factors between groups (mean ± SD)

Group	Number of cases (*n*)	HA (μg/L)		PIIIP (ng/L)		PICP (μg/L)	
		Preop	Postop 1d	Preop	Postop 1d	Preop	Postop 1d
Observation Group	40	73.21 ± 7.15	87.65 ± 8.19	8.46 ± 1.95	10.21 ± 1.53	110.75 ± 18.63	128.51 ± 10.97
Control Group	40	73.26 ± 7.11	101.53 ± 12.48	8.49 ± 1.74	12.34 ± 1.59	110.62 ± 18.43	140.16 ± 12.76
t-value	-	0.031	5.881	0.073	6.105	0.031	4.379
P-value	-	0.975	< 0.001	0.942	< 0.001	0.975	< 0.001

3.4. Comparison of liver function indicators between groups

One day after surgery, the liver function indicators of the observation group were superior, with a *P*-value < 0.05 in the inter-group comparison (**Table 4**).

Table 4. Comparison of liver function indicators between groups (mean ± SD)

Group	Number of Cases (*n*)	AST (U/L)		TBil (μmol/L)		ALT (U/L)	
		Preop	Postop 1d	Preop	Postop 1d	Preop	Postop 1d
Observation Group	40	58.16 ± 4.81	40.32 ± 3.98	88.42 ± 9.15	39.05 ± 4.16	62.45 ± 9.11	41.25 ± 3.78
Control Group	40	58.19 ± 4.77	46.77 ± 4.05	88.48 ± 9.11	45.19 ± 4.20	62.31 ± 9.08	50.37 ± 3.92
t-value	-	0.028	7.184	0.029	6.569	0.069	10.592
P-value	-	0.978	< 0.001	0.977	< 0.001	0.945	< 0.001

3.5. Comparison of complication rates between groups

The observation group had a lower complication rate, with a *P*-value < 0.05 in the inter-group comparison (**Table 5**).

Table 5. Comparison of complication rates between groups (*n*/%)

Group	Number of cases (*n*)	Refractory ascites	Intra-abdominal Infection	Wrapped pericaval effusion	Pulmonary infection	Reactive pleural effusion	Overall incidence rate
Observation group	40	0	0	1 (2.50)	1 (2.50)	0	5.00 (2/40)
Control group	40	1 (2.50)	1 (2.50)	3 (7.50)	2 (5.00)	1 (2.50)	20.00 (8/40)
χ^2-value	-	-	-	-	-	-	4.114
P-value	-	-	-	-	-	-	0.043

4. Discussion

Liver cancer is a malignant tumor of the digestive tract with a high mortality rate, primarily caused by hepatitis B or C virus infection, leading to malignant transformations from hepatitis or cirrhosis [3]. For patients with liver cancer without metastasis, radical surgery can be performed to completely remove the tumor, thereby improving the long-term quality of life of patients. Open surgery is a conventional treatment method that allows complete removal of the tumor under direct vision, with a high radical resection rate. However, it is highly invasive, involves significant intraoperative blood loss, and is prone to causing liver function damage, thereby prolonging postoperative recovery time and increasing the long-term recurrence rate [4].

Laparoscopic radical resection of liver cancer is a novel surgical approach for this disease. It utilizes laparoscopy for surgical operations, allowing for an expanded surgical field while clearly displaying the tumor's location, size, and the distribution of surrounding blood vessels, thereby facilitating the rational formulation of a surgical plan. Compared to open surgery, laparoscopic radical resection of liver cancer offers a broader exploration range, enabling observation of areas such as the pelvic rectum at the junction of the stomach, esophagus, and liver, thus facilitating the detection of occult lesions [5]. This surgical technique employs a four-port method for operation, allowing for simultaneous diagnosis and treatment, which can shorten the time for disease diagnosis and treatment and offers significant therapeutic advantages.

The results showed that the perioperative indicators of the observation group were significantly better than those of the reference group ($P < 0.05$). The reasons for this analysis are as follows: Laparoscopic surgery utilizes linear staplers during the operation, enabling proper handling of ductal stumps and reducing adverse events such as intraoperative bleeding [6]. During the surgery, the liver parenchyma can be separated to the level of the hepatic segmental duct, which is then clamped, and the tumor lesion is excised to achieve therapeutic goals. This approach minimizes damage to the surrounding liver tissue, resulting in better surgical outcomes. The inflammatory factor levels of the observation group on the first day after surgery were better than those of the reference group, while the fibrosis factor levels were lower than those of the reference group ($P < 0.05$). Inflammatory factors can assess the level of postoperative inflammatory response in patients and predict the degree of their stress response, thus allowing for the evaluation of the patient's inflammatory mediator levels and the determination of the negative impact of surgery on the patient's body [7].

Among inflammatory factors, IL-6 and TNF-α can be used to evaluate the severity of inflammation. Both are pro-inflammatory factors that are highly involved in the onset and development of inflammation, with their levels showing a positive correlation with the inflammatory response [8]. IL-2 regulates the activity of leukocytes, participates in the body's tumor surveillance process and antibody response process, has a strong effect on B lymphocytes, accelerates their proliferation, activates T cells, and thereby enhances the immune anti-cancer effect. After hepatectomy, liver fibrosis is a stress response with a relatively high incidence. Evaluating fibrosis factors can predict surgical hazards early and thus assess surgical efficacy [9]. After laparoscopic surgery, the aforementioned indicators are superior to those after open surgery, indicating that laparoscopic surgery induces a milder inflammatory response, can suppress stress responses, stabilize patients' postoperative vital signs, and facilitate patient recovery. The liver function indicators of the observation group one day after surgery were superior to those of the reference group ($P < 0.05$). The reason for this analysis is that laparoscopic surgery can preserve hepatic blood flow, reduce hepatic tissue hypoxia or ischemia, and thereby mitigate the extent of liver function damage [10]. Additionally, the precision and minimally invasive nature of laparoscopic surgery can reduce damage to liver tissue, resulting in excellent liver function indicators. The complication rate in the observation group was lower than that in the reference group ($P < 0.05$). The reason for this analysis is that laparoscopic surgery provides a clear field of view, allowing for continuous monitoring of surgical procedures and causing minimal damage to the tissues surrounding the liver, thus resulting in a lower risk of complications.

5. Conclusion

In conclusion, laparoscopic radical hepatectomy for liver cancer patients offers superior treatment outcomes compared to open surgery, achieving better perioperative indicators, reducing the degree of inflammatory and stress responses, protecting patients' liver function, and demonstrating high surgical safety benefits.

Disclosure statement

The author declares no conflict of interest.

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