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Analysis of the Effect of Laparoscopic Versus Open Cholecystectomy in Patients with Cholelithiasis and the Effect on CRP and IL-1β Levels

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Abstract: *Objective:* To evaluate the therapeutic effect of laparoscopic cholecystectomy (LC) and open cholecystectomy (OC) on cholelithiasis. *Methods:* 92 cases of cholelithiasis patients admitted to the hospital in the past 2 years were selected and grouped by random number table; the observation group was treated with LC; the reference group was treated with OC, and the inflammatory factor and other indexes were compared. *Results:* The total effective rate of the observation group was higher than that of the reference group, and the perioperative indexes were better than that of the reference group ($P < 0.05$). Preoperatively, the C-reactive protein (CRP) and interleukin-1β (IL-1β) levels and immune function indexes of the two groups were compared, and no difference was seen ($P > 0.05$). At 5 days postoperatively, the CRP and IL-1β levels of the observation group were lower than those of the reference group, and the immune function indicators were higher than those of the reference group ($P < 0.05$). The complication rate of the observation group was lower than that of the reference group ($P < 0.05$). *Conclusion:* LC can increase the effective rate of cholelithiasis patients, improve their perioperative indexes, reduce the inflammatory response, protect patients' immune function, and ensure higher surgical safety.

Keywords: Laparoscopic cholecystectomy; Open cholecystectomy; Cholelithiasis; CRP; IL-1β

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1. Introduction

Cholelithiasis is a disease where stones form in the biliary system and is most often combined with biliary pathologies such as cholecystitis, which slows down bile excretion and, in turn, leads to diseases such as cholestatic cirrhosis, which makes treatment more difficult [1]. The common treatment for this disease is resection surgery, which can remove stones and resect the area of biliary tract pathology, thus reducing the danger of the disease. However, conventional OC surgery is highly invasive, which can prolong the recovery time of patients and even lead to serious complications. In comparison, LC is minimally invasive and can

reduce postoperative inflammatory reactions and shorten the recovery period, thus improving the surgical prognosis [2]. Based on this, 92 cholelithiasis patients were selected in this study, and LC and OC treatments were performed respectively to compare the therapeutic effects of the two surgical modalities.

2. Data and methods

2.1. General information

The study was carried out from October 2021 to October 2023, and 92 cases of cholelithiasis patients were selected, divided evenly by random number table; 46 cases were selected in the observation group, 25 cases were male patients and 21 cases were female patients; the age ranged from 21 to 75 years old, with a mean of 48.95 ± 5.16 years old; the duration of the disease ranged from 4 months to 3 years, with a mean of 1.35 ± 0.42 years old. In the reference group, 46 cases were selected, 26 male patients and 20 female patients; the age ranged from 22 to 77 years old, with a mean of 49.08 ± 5.24 years old; and the duration of the disease ranged from 5 months to 3 years, with a mean of 1.41 ± 0.39 years. $P > 0.05$ after comparison of data between groups.

Inclusion criteria:

(1) Cholelithiasis was clearly diagnosed by abdominal CT;

(2) Met the indications related to resection;

(3) Normal mental status;

(4) Fully informed about the study.

Exclusion criteria:

(1) Concomitant cardiac, hepatic and renal diseases;

(2) Clearly suffering from malignant tumours;

(3) Obvious blood pressure or glucose abnormalities make it difficult to tolerate resection.

2.2. Methods

The operative procedure used in the observation group was LC: General anaesthesia was chosen, the patient was adjusted to the supine position and operated in the four-hole method. An incision was made at the superior border of the umbilicus, length = 10 mm, through which a pneumoperitoneum needle was inserted to achieve a pressure value of 10 to 14 mmHg, and a laparoscope was placed. Trcoar (10 mm) was placed below the xiphoid process and Trcoar (5 mm) was placed in the right anterior axillary line, below the right midclavicular point of the eccentric rib margin. Under laparoscopic guidance, the choledochal duct is freed by clamping it with a bioclip, moderately tractioning the gallbladder tissue, searching for the avascular zone in the anterior wall of the common bile duct, freeing the duct and then incising it longitudinally over a length of approximately 1.3 to 2.5 cm. A turnable duckbill forceps is placed in the infra umbilical foramen to probe the common bile duct and to remove the stone. The laparoscope was withdrawn through the superior umbilical orifice, and a choledochoscope was placed to observe the distribution of stones in the left and right hepatic ducts and the common bile duct, remove the stones with the aid of the choledochoscope basket, and flush the bile ducts two to three times. After biliary patency was restored, the T-tube was removed and placed into the supraumbilical marginal orifice and introduced into the common bile duct, and the common bile duct incision was closed with interrupted sutures, with a total of 2 to 3 stitches. The gallbladder was removed and taken out through the subxiphoid foramen, and then the abdominal cavity was irrigated before the T-tube was introduced in the clavicular coastal marginal foramen. Double fixation was done, and the drainage tube was left in the area of the gallbladder bed so that it was introduced through the axillary anterior line foramen, fixed in vitro, and finally,

suture closed the operation holes, and the operation was completed.

The operative procedure used in the reference group was OC: the same operation was performed under general anaesthesia in the same position as above so that the patient's epigastric and lumbar bridges corresponded to each other, and an abdominal rectus muscle incision was made in the right epigastric region, exposing the common bile ducts, and the bile was aspirated with the help of a syringe (1 mL). The common bile duct was incised by taking a fine silk thread and placing 1 suture in the anterior wall of the common bile duct bilaterally, and the stones were removed with the help of a stone extractor. A choledochoscope was placed through the common bile duct incision to observe the status of the common hepatic duct and the common bile duct. A T-tube was left in the common bile duct, the common bile duct incision was closed with interrupted, full-layer sutures, and the common bile duct was filled with saline by instilling saline into the T-tube to assess the leakage of the suture. After ensuring that there is no leakage, the abdominal cavity is irrigated and the abdomen is closed.

2.3. Observation indicators

(1) Perioperative indicators: Observe the operation time as well as the incision length and other indicators.
(2) Inflammatory factors: before and 5 days after surgery, fasting venous blood was collected in the amount of 5 mL, and the supernatant was extracted after centrifugation, and CRP and IL-1β were measured by enzyme-linked immunosorbent assay.
(3) Immune function indexes: fasting venous blood was collected at the same time, the volume was 5 mL, and $CD3^+$, $CD8^+$ and $CD4^+$ were measured by immunofluorescence method.
(4) Complications: incision infection, intestinal adhesion, subcutaneous emphysema and bile leakage.

2.4. Efficacy evaluation criteria

(1) Cure: complete removal of stones by abdominal CT examination after surgery.
(2) Clinically effective: a small number of stones can be seen in the postoperative CT examination.
(3) Clinically ineffective: a large number of stones can be seen in the postoperative CT examination.

2.5. Statistical analysis

Data by SPSS 28.0 software disposal, measurement value by *t* value comparison/test, count value by χ^2 value comparison/test, statistical significance is counted as *P* value less than 0.05.

3. Results

3.1. Comparison of total effective rate between groups

The total effective rate of the observation group is significantly higher than that of the reference group, $P < 0.05$. See **Table 1**.

Table 1. Comparison between groups total effective rate (*n*/%)

Subgroup	Disease Cure	Clinically effective	Clinically Ineffective	Total Effective
Observation group (*n* = 46)	25 (54.35)	20 (43.48)	1 (2.17)	97.83 (45/46)
Reference group (n = 46)	21 (45.65)	18 (39.13)	7 (15.22)	84.78 (39/46)
χ^2	-	-	-	4.929
P	-	-	-	0.026

3.2. Comparison of perioperative indicators between groups

The perioperative indicators of the observation group were all better than those of the reference group, $P < 0.05$. See **Table 2**.

Table 2. Comparison of perioperative indicators between groups (mean ± SD)

Subgroups	Operative time (min)	Incision length (cm)	Intraoperative haemorrhage (mL)	Postoperative expiratory time (min)	Recovery time of gastrointestinal function (h)	Postoperative time out of bed (h)	Length of hospital stay (d)
Observation group (n = 46)	50.36 ± 4.16	3.14 ± 0.28	42.38 ± 4.13	15.23 ± 1.67	11.74 ± 2.31	8.65 ± 1.97	6.88 ± 1.54
Reference group (n = 46)	84.21 ± 6.94	16.46 ± 2.37	103.22 ± 9.51	37.61 ± 1.89	30.23 ± 2.69	15.05 ± 1.89	10.43 ± 1.82
t	28.374	37.855	39.799	60.183	35.368	15.900	10.099
P	0.000	0.000	0.000	0.000	0.000	0.000	0.000

3.3. Comparison of inflammatory factor between groups

Preoperatively, the inflammatory factor of the two groups was compared, $P > 0.05$. 5 days postoperatively, the inflammatory factor of the observation group was lower than that of the reference group, $P < 0.05$. See **Table 3**.

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

Subgroup	CRP (mg/L)		IL-1β (pg/mL/)	
	Before treatment	After treatment	Before treatment	After treatment
Observation group (n = 46)	9.82 ± 1.75	3.11 ± 0.58	132.53 ± 19.68	69.46 ± 5.71
Reference group (n = 46)	9.89 ± 1.71	6.41 ± 1.08	132.11 ± 19.52	96.29 ± 5.83
t	0.194	18.258	0.103	22.299
P	0.847	0.000	0.918	0.000

3.4. Comparison of immune function indicators between groups

Preoperatively, the immune function indexes of the two groups were compared, $P > 0.05$. 5 days after surgery, the immune function indexes of the observation group were higher than those of the reference group, $P < 0.05$. See **Table 4**.

Table 4. Comparison of immune function indexes between groups (mean ± SD/%)

Subgroup	CD3+		CD8+		CD4+	
	Before treatment	After treatment	Before treatment	After treatment	Before treatment	After treatment
Observation group (n = 46)	61.27 ± 6.84	59.86 ± 5.27	26.22 ± 3.15	21.91 ± 2.84	43.37 ± 4.91	36.98 ± 3.84
Reference group (n = 46)	61.22 ± 6.91	49.35 ± 5.14	26.28 ± 3.11	18.32 ± 2.76	43.33 ± 4.85	30.18 ± 3.76
t	0.035	9.683	0.092	6.148	0.039	8.582
P	0.972	0.000	0.927	0.000	0.969	0.000

3.5. Comparison of complication rate between groups

The complication rate of the observation group was lower than that of the reference group, $P < 0.05$. See **Table 5**.

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

Subgroup	Incision infection	Intestinal adhesions	Subcutaneous emphysema	Bile leakage	Incidence
Observation group (*n* = 46)	0	1 (2.17)	0	0	2.17 (1/46)
Reference group (n = 46)	1 (2.17)	2 (4.35)	2 (4.35)	1 (2.17)	13.04 (6/46)
χ^2	-	-	-	-	3.866
P	-	-	-	-	0.049

4. Discussion

The physiological function of the gall bladder is to store bile, regulate the internal pressure of the biliary tract, and participate in the process of immunomodulation, which belongs to the digestive organs. Cholelithiasis is a highly prevalent biliary system disease, mostly combined with sphincter spasm or oedema, which blocks the excretion of bile and pancreatic fluid, causing inflammatory reactions in the biliary system and pancreatic tissue [3,4]. The principle of clinical treatment for cholelithiasis is to remove the stones and restore the digestive function of the biliary system, and resection is the most commonly used treatment. OC surgery is the basic procedure that can make an incision in the right upper abdomen and remove the stones under direct vision, and its surgical process is simple and requires less skill for the operator [5]. However, this procedure is more invasive, may retain small stones, and has more complications with surgical defects. In recent years, minimally invasive surgery has become a novel procedure for this disease and is most common with LC. Its observation of stone status, location and number with the help of laparoscopy can ensure the precision and minimal invasiveness of surgical operation, so the surgical effect is excellent [6].

The results showed that the total effective rate of the observation group was higher than that of the reference group, and the perioperative indicators were better than those of the reference group ($P < 0.05$). It can be seen that LC surgery can improve surgical efficacy, shorten the duration of surgery, prevent intraoperative hemorrhage, and accelerate postoperative recovery. The reason is that LC surgery can use laparoscopy to obtain a wide and clear surgical field, avoiding damage to healthy tissues, so the bleeding is less and the operation takes a shorter time [7]. Moreover, LC surgery does not affect the peristaltic amplitude and direction of the gastrointestinal tract, which can maintain regular gastrointestinal peristalsis and avoid stagnation of intestinal contents, thus shortening the recovery time of gastrointestinal function after surgery. In addition, LC does not cause serious damage to the patient's abdominal muscles, nerves and blood vessels and can accurately probe the nerves and tissues near the gall bladder, so the operation is more accurate, which will significantly improve the success rate of the operation [8]. At 5d after surgery, the CRP and IL-1β levels of the observation group were lower than those of the reference group, and the immune function indicators were higher than those of the reference group ($P < 0.05$). It can be seen that LC surgery can reduce postoperative inflammatory reactions and protect the body's immune function. Under normal circumstances, surgical operations increase the release of inflammatory factors and free oxygen radicals, leading to inflammatory reactions and aggravating oxidative stress damage [9]. Among the inflammatory factors, CRP is synthesized in hepatocytes and is highly bound to phosphorylcholine on the surface of the cell membrane, which activates the complement system and interacts with the platelet-activating factor, which in turn participates in the inflammatory response process. IL-1β is synthesized in macrophages as well as monocytes, which belong to the inflammatory mediators and evaluate the degree of inflammatory response [10]. During the LC surgery, for the abdominal cavity organs, the less intrusive and small incision will significantly reduce the release of inflammatory factors, which in turn will reduce postoperative inflammation. Among the indicators of immune function, CD3+

and CD8+ are both immune cells that can evaluate the body's immune ability. LC surgery does not cause serious damage to the immune barrier, which can maintain the stability of the internal environment, thus reducing the stress response and protecting the body's immunity [11]. The complication rate of the observation group was lower than that of the reference group ($P < 0.05$). The reason is that LC has the advantage of being minimally invasive, and the whole operation can be completed with the help of laparoscopy, which is less damaging to the organism and the healing time of postoperative incision is short, so the surgical safety benefit is higher.

5. Conclusion

In conclusion, LC surgery has a superior therapeutic effect on patients with cholelithiasis compared to OC, and it can be used as a common procedure for this disease to obtain a better surgical prognosis.

Disclosure statement

The author declares no conflict of interest.

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