Review Article
Clinical effect of laparoscopic radical gastrectomy for gastric cancer and its influence on the serum index of patients

Haiping Zhao, Shiwei Zhang

Department of General Surgery, The First People's Hospital of Fuyang, Hangzhou 310000, Zhejiang Province, China

Abstract: To explore the clinical effect of laparoscopic-assisted radical operations on gastric carcinoma versus open surgery (OS) in the treatment of gastric cancer and the difference in relevant indicators in the serum of patients, A total of 80 gastric cancer patients with tumor node metastasis (TNM) staging for II stage and III stage were used as the subjects in this research based on the type of gastric cancer radical surgery. Based on the surgical methods, they were divided into the OS group and the laparoscopic-assisted radical operation of gastric carcinoma group (LAS group) for follow-up studies. First, the difference in related indicators in the perioperative period of patients in two groups were compared. Then, expression levels of inflammatory-related indicators in the serum were detected by ELISA. Finally, the levels of CD4+, CD8+ and CD4+/CD8+ cells in the patients' blood were detected by flow cytometry, and the difference of IgG and IgM in serum was detected by immunity transmission turbidity. The results showed that the incision length, intraoperative blood loss, postoperative activity time, postoperative exhaust time, and length of hospital stay in the LAS group were all significantly lower than those in the OS group (P<0.01). The incidence of postoperative complications in the LAS group was significantly lower than that in the OS group (P<0.05). The expression of inflammatory-related indicators in the LAS group were significantly lower than those in the OS group (P<0.05). The expression of CD4+, CD4+/CD8+, IgG, and IgM in the LAS group were significantly higher than those in the OS group (P<0.05). Therefore, compared with traditional OS, the laparoscopic-assisted radical operation of gastric carcinoma has the advantages of reducing the risk of complications, intraoperative blood loss, and the sense of pain in the patient, as well as speeding up the recovery, etc., so it is a safe and feasible minimally invasive surgical method.

Keywords: Laparoscopic-assisted radical operation of gastric carcinoma, OS, gastric cancer, clinical effect, inflammation, immune

Introduction

Gastric cancer is one of the more common types of malignancies within the digestive system and it ranks fourth in the incidence of malignancies. Patients with gastric cancer may have symptoms such as loss of appetite, anemia, and abdominal pain. As the disease progresses, the patient may have symptoms such as abdominal effusion and swollen lymph nodes [1-3]. For patients with gastric cancer, effective treatment is essential to improve the prognosis of the disease. Currently, open radical gastrectomy is often used clinically to treat the gastric cancer, but this method causes

trauma to patients and has disadvantages such as large intraoperative blood loss and slow postoperative recovery rate [4, 5]. With the rapid development of medical technology, laparoscopic-assisted radical operation of gastric carcinoma for patients has been used in clinical practice.

Laparoscopic surgery for gastric cancer is a minimally invasive surgical method, which has the advantages of little trauma, minimal intraoperative bleeding, and fast postoperative recovery [6]. The key and difficult point in laparoscopic-assisted radical operation of gastric carcinoma is the dissection of the gastric lymph

node. Current studies have shown that the effect of laparoscopic-assisted radical operation of gastric carcinoma in lymph node dissection is worse than that of open radical gastrectomy [7, 8]. However, patients with stage Ia, stage Ib and stage II who underwent laparoscopic-assisted radical operation of gastric carcinoma had a disease free survival of more than 85% in 5 years [9, 10]. White blood cells (WBC), C-reactive protein (C-RP), tumor necrosis factor-α (TNF-α), and interleukin-6 (IL-6) are closely related to the inflammatory response of the human body, and can reflect the local inflammatory response of patients after surgery [11]. The changes in levels of CD4+, CD8+, CD4+/CD8+ T lymphocyte subsets and IgG and IgM in serum can reflect the functional changes of cellular and humoral immunity in the human body [12]. At present, there are some relevant reports on laparoscopic-assisted radical operation of gastric carcinoma, but there are few studies comparing the clinical effect between laparoscopic-assisted radical operation of gastric carcinoma and open radical gastrectomy on inflammation-related indicators in the serum and immune system of patients.

Therefore, in this study, patients with distal gastric cancer who were treated with radical gastrectomy and whose TNM stage was stage II and III were divided into two groups (OS group and LAS group). Differences between the two groups were compared as the indicators related to surgery, pathology and the probability of postoperative complications. In addition, differences in expression levels of WBC, C-RP, TNF-α and IL-6 inflammatory cells and related indicators of the immune system were compared and analysed. The results of this study were intended to provide a theoretical basis for clinical application of laparoscopic-assisted radical operation of gastric carcinoma in the future.

Materials and methods

Research subjects

Data of patients with distal gastric cancer who received radical gastrectomy in the The First People's Hospital of Fuyang from June 2016 to December 2018 were retrospectively analysed. A total of 80 patients were selected, including 47 male patients and 33 female patients. The average age of the patients was 45.76 ± 6.56 years old, and the tumor diameter was 6.15 ±

1.46 cm. Confirmed by postoperative pathology, there were 26 patients within II period of TNM staging, and 54 patients within III period. The inclusion criteria were as follows: patients who had been diagnosed with distal gastric cancer by enhanced upper abdominal CT scan and pathological biopsy before surgical treatment; patients with tumor lesions less than 10 cm in diameter; the patients whose imaging results showed no distant metastasis of the tumor; and patients with no preoperative contraindications. The exclusion criteria were as follows: patients who had received radiotherapy or chemotherapy before surgery; patients complicated with physiological dysfunction of important organs such as heart and related diseases such as coronary heart disease; patients with severe infection; and patients who had received abdominal surgery. This study had been approved by the Ethics Committee of The First People's Hospital of Fuyang. The subjects and their families had been informed of the study contents and surgical procedures, and signed the informed consent.

This experiment got the approval of the Medical Ethics Committee of The First People's Hospital of Fuyang and this study was in line with the Declaration of Helsinki.

Surgical approach

The patients were divided into two groups, among them, 40 patients underwent OS for radical gastrectomy, and 40 patients underwent LAS for distal radical gastrectomy. All patients in the two groups received routine surgical preparation before surgery, and received skin preparation and oral laxatives one day before surgery. Food and water were forbidden 8 hours before surgery and a gastric tube was put in. During this period, patients were given appropriate intravenous rehydration. The patients were anesthetized by intravenous propofol injection, and the catheter was placed after the anesthesia.

According to the treatment standard of gastric cancer, patients in the OS group were placed in a supine position on the operating table. An incision of about 15 cm was made from the xiphoid process to the left part around the umbilicus, and then the operation of gastric dissociation was completed with an ultrasonic knife. The surgery was carried out strictly in

accordance with the operating standards of tumor-free surgery. At the same time, the corresponding lymph tissue was cleaned according to the D2 surgical standard and the cleaning was combined with the location of the lesion tissue of tumor. After the surgery, hemostasis was performed and the abdominal cavity was rinsed with sterile distilled water, and finally a drainage tube was placed on the abdominal wall.

Patients in the LAS group were placed in a supine position, lying flat on the operating table. After the legs were separated at a certain angle, a small incision of about 10 mm was cut in the left side of their navel and a veress needle was inserted to maintain the pressure of 12 mmHg. After the placement of 10 mm trocar, laparoscopy was carried out to check whether the tumor lesions had metastasized to other organs or omentum majus, or the pelvic floor, etc. If there was no abnormal condition, a 10 mm trocar was placed as the main operating hole 2 cm below the intersection point of the rib edge of the left axillary front. At the intersection of the left clavicle midline and umbilicus at 2 cm, a 5 mm trocar was disposed as an auxiliary operating hole, and another 5 mm trocar was placed at the same position on the opposite side as a traction hole. After abdominal examination to determine the location of the tumor and the scope of tumor resection, laparoscopy and operating instruments were used for the surgery. The omentum majus was the first area treated and the lymph nodes in the superior mesenteric vein were dissected after the transverse mesenteric was separated. Then, the left blood vessel and part of the short vessel, the capsula pancreatis, the left gastric vessel, and the ligaments of the liver and stomach were separated, and the surrounding lymph nodes were dissected. The duodenum was severed and the abdominal organs were examined through a 6 cm incision in the middle of the upper abdomen. After extraction of gastric tissue, the resection of distal gastric cancer was completed with mild treatment of remnant gastroduodenum and an indwelling drainage tube.

Both groups of patients underwent class I routine care after surgery, and food and water were prohibited temporarily. Cardiac monitoring and oxygen inhalation were performed while maintaining the patency of the gastric tube and the opening of the indwelling urinary tube (extubation was performed according to specific conditions).

Detection of inflammatory factors

The enzyme-linked immunosorbent assay (ELISA) was used to detect the expression of WBC, C-RP, TNF-α, and IL-6 in the patients' blood. Before testing, the reagents in the ELISA kit (ThermoFisher Scientific, USA) were equilibrated at room temperature. For the formal testing, a 96-well microtiter plate was used and set with the blank, standard, and sample wells to be tested. Then, 100 µL of sample diluent was added to the blank well, 100 µL of standard solution was added to the standard well, and 100 µL of the sample to be tested was added into the sample well. After gently shaking and mixing, it was covered and incubated at 37°C for 2 hours. The liquid was discarded, and 100 µL of detection solution A was added to each well after the wells were dried, then it was covered and incubated at 37°C for 1 hour. Again, the liquid was discarded, the plate was washed 3 times, for 1 min each time, then 100 µL of detection solution B was added to each well, and it was covered and incubated at 37°C for 1 hour. The liquid was discarded, the plate was washed for 3 times, with 1 min each time, 90 µL of substrate was added to each well, and then it was covered and incubated at 37°C for 30 min. Then, 50 µL of stop solution was added to each well to stop the reaction, and the microplate was placed immediately on the microplate reader at 450 nm wavelength to detect the optical density of each well.

Detection on levels of T lymphocyte subsets

Flow cytometry was used to detect changes in the levels of CD4+, CD8+ and CD4+/CD8+ cells in the patients' blood; a dedicated test tube for flow cytometry was used, 10 µL of different fluorescently labelled monoclonal fluorescent antibodies was added to each well, placed and incubated after it was fully mixed at room temperature in the dark for 15 min. The test tube was placed in a vortex shaker and 600 µL of hemolytic agent A dropwise was added during the shaking process for 5 seconds. Then, 250 µL of hemolytic agent B was added immediately, mixed well and placed in a centrifuge to centrifuge at 1000 rpm for 5 min. The supernatant was discarded and 2 mL of phosphate buffered

Table 1. General data between the two groups of patients

General information		OS group (n=40)	LAS group (n=40)	χ^2 value	P value
Gender	Male	24 (60.00%)	23 (57.50%)	1.043	0.323
	Female	16 (40.00%)	17 (42.50%)		
Age (years old)	≤50	27 (67.50%)	26 (65.00%)	1.282	0.225
	>50	13 (32.50%)	14 (35.00%)		
Tumor diameter (cm)	≤5	24 (60.00%)	25 (62.50%)	1.351	0.216
	>5	16 (40.00%)	15 (37.50%)		
TNM staging	II stage	12 (30.00%)	14 (35.00%)	2.110	0.121
	III stage	28 (70.00%)	26 (65.00%)		

saline (PBS) was added to wash the precipitate twice. It was then centrifuged at 1000 rpm for 5 min again; the supernatant was discarded and 500 μL of PBS was added, mixed and placed in a flow cytometer for detection.

Detection of expression level of serum immunoglobulin

The difference in the expression levels of IgG and IgM in the serum of patients was detected by immunoturbidimetry. The IgG and IgM antibody solutions were diluted first, by a factor of 20, and 200 μL of diluted antibody solution was added to each reaction tube. The multi-purpose polyethylene glycol (PEG) turbidity buffer was used to appropriately dilute the sample to be tested, and then 15 μL of the diluted sample to be tested was dropped into the reaction tube and mixed fully. The mixed sample was placed in a water bath for water bath reaction, and the PEG turbidity buffer was used as a blank control group for 0 regulation of the semi-automatic biochemical analyser. Finally the absorbance of each well was detected at the wavelength of 340 nm.

Observation indicators

Surgical incision length, intraoperative blood loss, operation duration, postoperative activity time, postoperative exhaust time, length of hospital stay, and other relevant indicators were recorded and compared between the two groups. In addition, the distance between the upper and lower incisions and tumor, the number of lymph nodes dissected (detected by pathologists), and other relevant pathological indicators were compared between the two groups. Patients were visited and followed up by telephone 1 to 12 months after the surgery,

and the complications of incision infection, abdominal infection, and postoperative bleeding were compared between the two groups. The two groups of patients were examined for differences in the expression of WBC, C-RP, TNF-α and IL-6 in the blood of the patients 1 day before and 3 days after the operation, and detected changes in the levels of CD4+, CD8+ and CD4+/CD8+ cells in the blood of the patients, and detected the patients difference in the expression of IgG and IgM in serum.

Statistical analysis

SPSS 19.0 software was adopted for statistical analysis, and the measurement data obtained in the study were expressed by $\overline{x}\pm sd$. T test was used to compare various indicators between the two groups. The one-way ANOVA process was taken for comparison of multi groups. χ^2 test was utilized to compare the counting data. When P<0.05, the difference between the groups was considered statistically significant.

Results

Comparison of the patients' general information

The general information of patients in the OS group and LAS group was compared. As can be observed from **Table 1**, there were no significant differences in gender, age, tumor diameter, and TNM staging between patients in the two groups (P>0.05).

Comparison of surgical indicators in patients

The incision length, intraoperative blood loss, operation duration, postoperative exhaust time, postoperative activity time, and LOS of patients in the OS group and LAS group were compared. As can be observed from **Figures 1** and **2**, the incision length, intraoperative blood loss, postoperative exhaust time, postoperative activity time, and LOS of patients in the LAS group were all significantly lower than those in the OS group (P<0.01). While the operation
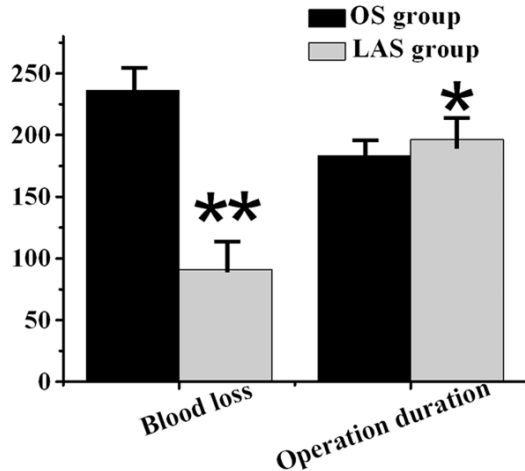
Figure 1. Comparison of intraoperative blood loss and operation duration in two groups of patients. Note: ** indicated an extremely significant difference compared with the OS group (P<0.01); * indicated a significant difference compared with the OS group (P<0.05).

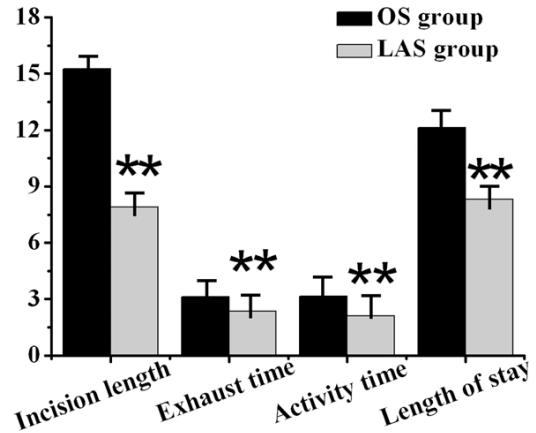**Figure 2.** Comparison of intraoperative incision length, postoperative exhaust time, postoperative activity time, and LOS in two groups of patients. Note: ** indicated an extremely significant difference compared with the OS group (P<0.01); * indicated significant difference compared with the OS group (P<0.05).

time of patients in the LAS group was significantly longer than that in the OS group (P<0.05).

Comparison of relevant indicators of postoperative pathology and complications in patients

The difference of pathologically related indicators of postoperative upper and lower incisal edges, tumor distance, and lymph node dissection of patients between the OS group and LAS group were compared. As can be observed from **Table 2**, there was no significant difference between the OS group and LAS group in the distance between the upper incisal edge and tumor, the distance between the lower incisal edge and tumor, and the amount of lymph node dissection (P>0.05).

After that, the differences between the OS group and LAS group in postoperative incision infection, pulmonary infection, postoperative bleeding, and other complications were compared. As can be observed from **Figure 3**, patients in both groups suffered from postoperative complications After comparing the total probability of complications, it was found that the incidence rate of complications in the LAS group was significantly lower than that in the OS group (P<0.05).

The CT images of some patients with gastric cancer are shown in **Figure 4**. The CT of a

patient undergoing open abdominal surgery are shown in **Figure 4A**. It can be seen that there were some soft tissue masses in the rectum, and the upper intestine was obviously dilatated with gas, and with extensive liquid levels. It was considered to be rectal occupation complicated with intestinal obstruction. The right pneumothorax, aortic tortuous, and the metastasis of the right 5th rib are shown in **Figure 4B**. A massive soft tissue shadow could be seen on the right side of the aorta abdominalis, which was considered to be a postoperative space-occupying lesion. In **Figure 4C**, irregular thickening of residual gastric wall was observable, and tissue shadows with crumby structure were observed in the retroperitoneum. The surrounding boundary was not smooth enough, so recurrence could be ruled out.

Comparison of serum inflammation-related indicators of patients before and after surgery

The changes in the amount of WBCs, the concentration of C-RP, TNF-α, and IL-6 in the blood of patients in the OS group and LAS group were compared, respectively, and the results were shown in **Figures 5** and **6**. As can be observed from **Figure 5A**, the amount of WBCs after surgery in the OS group was $13.97 \pm 2.82 \times 10^9$/L, which was significantly higher than the that ($6.24 \pm 1.43 \times 10^9$/L) before surgery (P<0.01). The concentrations of C-RP, TNF-α, and IL-6 in serum of patients after surgery were 50.82 ±

Table 2. Pathology-related indicators between the two groups of patients after surgery

Group	Distance between the upper incisal edge and the tumor (cm)	Distance between the lower incisal edge and the tumor (cm)	Amount of lymph node dissection (case)
OS group (n=40)	6.67 ± 1.14	3.77 ± 1.23	22.08 ± 3.54
LAS group (n=40)	6.82 ± 1.37	3.63 ± 1.36	21.92 ± 2.88
t value	-1.226	-1.526	-2.021
P value	0.511	0.349	0.313
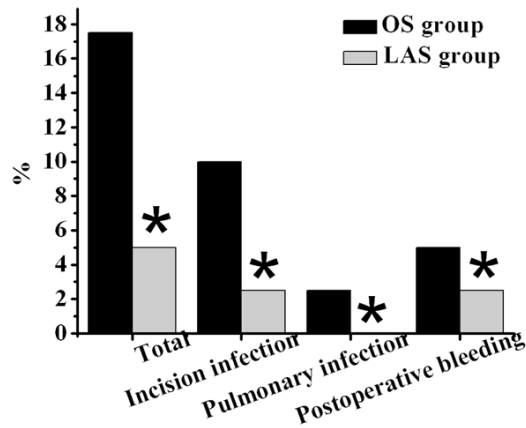
Figure 3. Postoperative complications between the two groups of patients. Note: * indicated a significant difference compared with OS group (P<0.05).

10.32 mg/L, 208.96 ± 39.24 pg/mL, and 73.28 ± 12.51 pg/mL, respectively, which were significantly higher than those in serum of patients before surgery, which were 2.11 ± 0.63 mg/L, 11.03 ± 2.14 pg/mL, and 4.51 ± 1.07 pg/mL, respectively (P<0.01). As can be observed from **Figure 5B**, the amount of WBCs after surgery in the LAS group was 12.19 ± 2.21×10^9/L, which was significantly higher than that before surgery, which was 6.43 ± 1.45×10^9/L (P<0.01). The concentrations of C-RP, TNF-α, and IL-6 in the serum of patients after surgery were 39.35 ± 10.16 mg/L, 163.28 ± 42.07 pg/mL and 55.82 ± 10.72 pg/mL, respectively, which were significantly higher than those in the serum of patients before surgery, which were 2.09 ± 0.50 mg/L, 10.04 ± 1.26 pg/mL, and 4.49 ± 1.08 pg/mL, respectively (P<0.01). The difference in amount of WBC and concentrations of C-RP, TNF-α, and IL-6 of patients between the OS and LAS group were compared. As can be observed from **Figure 6**, the amount of WBCs and concentration of C-RP in the LAS group were significantly lower than those in OS group (P<0.05), while the concentration of TNF-α and IL-6 were significantly lower than those in OS group (P<0.01).

*Comparison on levels of immune-related cells in patients before and after surgery*

The changes in levels of CD4+, CD8+, and CD4+/CD8+ cells in the OS group and LAS group before and after surgery were respectively compared, and the results were shown in **Figure 7** and **Table 3**. As can be observed from **Figure 7A**, the levels of CD4+ and CD4+/CD8+ in the blood of patients after surgery in the OS group were significantly lower than those before surgery (P<0.01), while the level of CD8+ was significantly higher than that before surgery (P<0.01). As can be observed from **Figure 7B**, the levels of CD4+ and CD4+/CD8+ in the blood of patients after surgery in the LAS group were significantly lower than those before surgery (P<0.01), while the level of CD8+ was significantly higher than that before surgery (P<0.01). The difference in levels of immune-related cells after surgery between the two groups were compared. As can be observed from **Figure 8**, levels of CD4+ and CD4+/CD8+ after surgery in the LAS group were significantly higher than those in OS group (P<0.01), while the level of CD8+ was significantly lower than that in OS group (P<0.01).

Comparison of the expression of related antibodies in the serum in patients before and after surgery

The difference in expression of IgG and IgM in serum between the OS group and LAS group before and after surgery were compared, as shown in **Figure 9**. As can be observed from **Figure 9A**, the expression of IgG and IgM after surgery in the OS group was significantly lower than those before surgery (P<0.01). As can be observed from **Figure 9B**, the expression of IgG and IgM in the LAS group was significantly lower than those before surgery (P<0.01). Then, the differences in expression of IgG and IgM in serum between the OS group and the LAS

Figure 4. Partial CT images of gastric cancer patients after surgery. Note: (A) Was the image of a male patient (open abdominal surgery), aged 61 years; (B) Was the image of a male patient (laparoscopic surgery), aged 54 years; and (C) Was an image of a female patient (laparoscopic surgery), age 68 years.
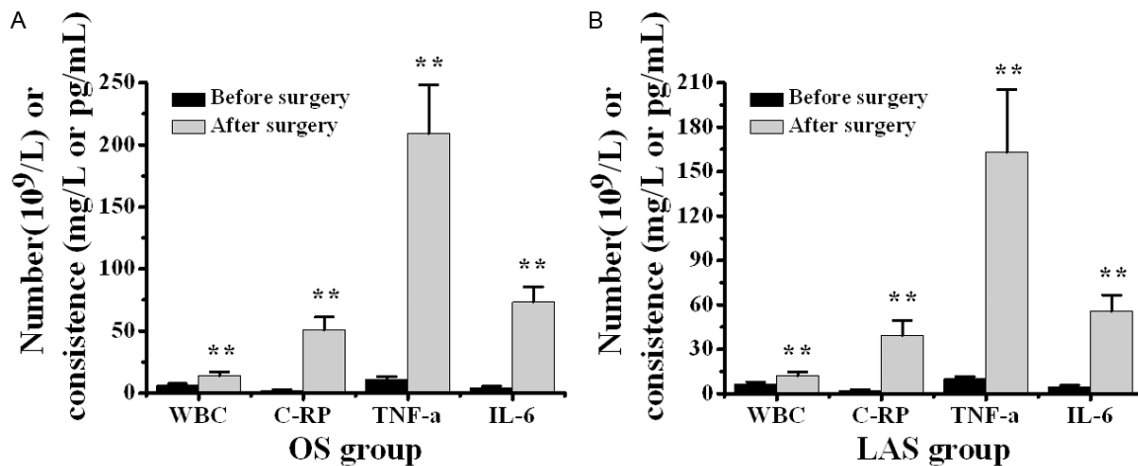
Figure 5. Comparison on levels of WBC, C-RP, TNF-α, and IL-6 in patients in OS group and LAS group before and after surgery. Note: (A) Difference between serum inflammatory-related indicators before and after surgery in the OS group. (B) Difference of serum inflammatory-related indicators before and after surgery in the LAS group. ** indicated that there was an extremely significant difference compared with the indicator before surgery, P<0.01.
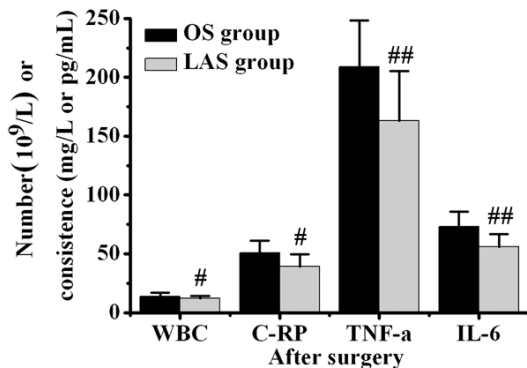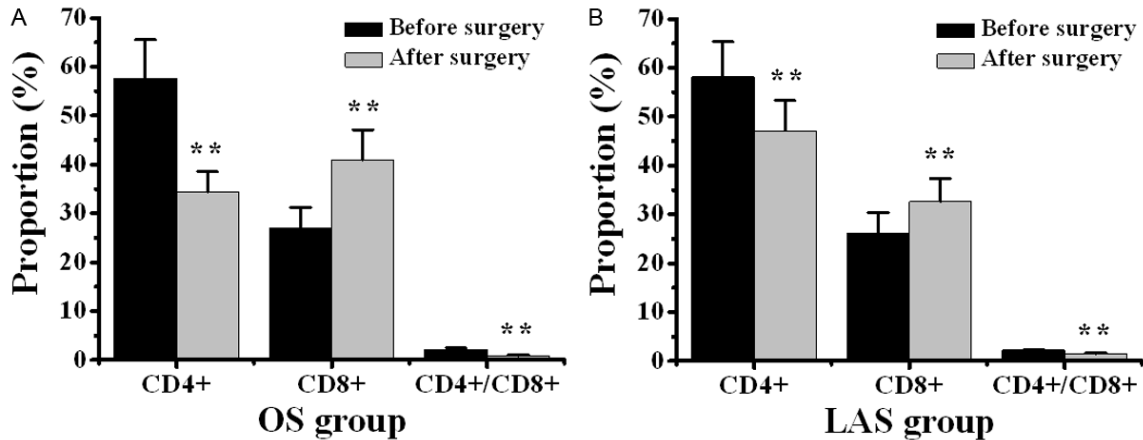

Figure 6. Comparison on levels of WBC, C-RP, TNF-α, and IL-6 after surgery between the two groups of patients. Note: ## indicated that there was an extremely significant difference between OS group and LAS group, P<0.01.

group were compared. As can be observed from **Figure 9C**, the expression of IgG in the serum of the LAS group was significantly higher than that of OS group (P<0.01), while the expression of IgM was significantly higher than that in the OS group (P<0.05).

Discussion

Gastric cancer is one of the common malignant tumors of the digestive tract, and it is characterized by high morbidity and mortality. Due to the side effects of traditional OS such as long operation time, large amount of trauma, and many complications, patients often suffer great pain. This encourages physicians to make a breakthrough in surgical methods. In recent years, laparoscopy has been gradually applied in the diagnosis and treatment of gastric cancer, but the specific advantages are still unclear [13, 14]. Therefore, the clinical efficacy of laparoscopic surgery and traditional OS for gastric

Figure 7. Comparison of the proportion of CD4+, CD8+, and CD4+/CD8 cells before and after surgery in patients in OS group and LAS group. Note: (A) Difference in proportions of immune-related cells in the OS group before and after surgery. (B) Difference in proportions of immune-related cells in the LAS group before and after surgery. ** indicated that there was an extremely significant difference between the OS group and LAS group, P<0.01.

Table 3. Comparison on levels of T lymphocyte subsets in patients before and after surgery

Group		CD4+	CD8+	CD4+/CD8+
OS group (n=40)	Before surgery	57.67 ± 7.85	26.98 ± 4.26	2.14 ± 0.32
	After surgery	34.31 ± 4.28	40.86 ± 6.29	0.84 ± 0.21
	t1	3.351	3.226	3.327
	P1	0.008	0.009	0.000
LAS group (n=40)	Before surgery	58.11 ± 7.26	26.19 ± 4.17	2.22 ± 0.17
	After surgery	47.08 ± 6.23	32.59 ± 4.73	1.44 ± 0.20
	t2	3.039	3.129	4.012
	P2	0.010	0.008	0.000
t3		4.039	3.998	3.881
P3		0.000	0.000	0.000

Note: T1 and P1 were comparative statistics of differences in the OS group before and after surgery; T2 and P2 were the comparative statistics of differences in the LAS group before and after surgery; T3 and P3 were comparative statistics of differences between the OS group and LAS group after surgery.

Figure 8. Comparison of the proportions of CD4+, CD8+, and CD4+/CD8 cells after surgery in the two groups of patients. Note: ## indicated that there was an extremely significant difference between OS group and LAS group, P<0.01.
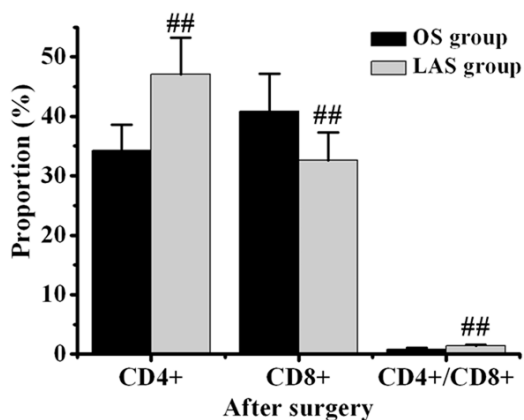
cancer patients was compared in this study. The results revealed that the incision length, intraoperative blood loss, postoperative exhaust time, postoperative activity time, and LOS in the LAS group were significantly lower than those in the OS group (P<0.01). The results of this study was consistent with the research results of Kodera et al. (2019) [15], suggesting that laparoscopic technology can reduce the trauma of radical resection and make the operation more precise, which was conducive to pain relief of patients, and shorter length of hospital stay; thus, greatly reducing the financial burden of patients' families. However, it was also found in this study that the operation time of patients in the LAS group was significantly longer than that in the the OS group (P<0.05), which was in stark contrast to the fact that Sang et al. (2019) [16] found that the operation time of laparo-
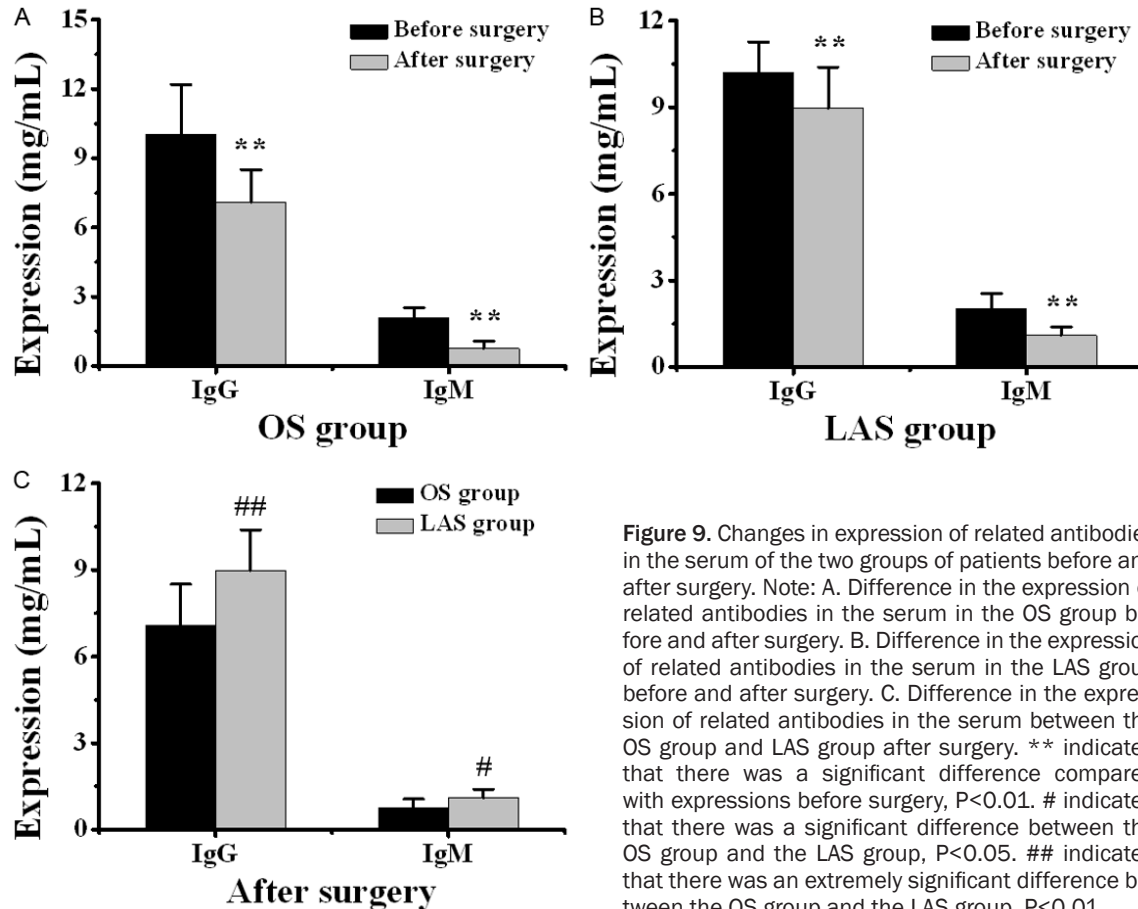
Figure 9. Changes in expression of related antibodies in the serum of the two groups of patients before and after surgery. Note: A. Difference in the expression of related antibodies in the serum in the OS group before and after surgery. B. Difference in the expression of related antibodies in the serum in the LAS group before and after surgery. C. Difference in the expression of related antibodies in the serum between the OS group and LAS group after surgery. ** indicated that there was a significant difference compared with expressions before surgery, P<0.01. # indicated that there was a significant difference between the OS group and the LAS group, P<0.05. ## indicated that there was an extremely significant difference between the OS group and the LAS group, P<0.01.

scopic patients was not significantly different from that in the OS group. It may be because the application of laparoscopic technology required a certain technical level and operating experience of the chief surgeon, and it may also related to the quality of the instrument.

To better analyze the safety of laparoscopic surgery, the complications of the two groups were also compared in this study. It was found that the proportion of laparoscopic patients complicated with incision infection, pulmonary infection, and postoperative bleeding were significantly lower than those in the OS group (P<0.05). This was the same as the study results of Lee et al. (2019) [17], indicating that laparoscopic technology could reduce the risk of postoperative complications in patients with gastric cancer and as a result was safe and feasible. In addition, with the popularization of external stapler in the future, intraoperative digestive tract reconstruction will become safer, and the risk of postoperative complica-

tions will be further reduced. C-RP, a protein synthesized by the liver, is one of the most important and sensitive markers of acute reactions in the human body, and it can reflect the degree of acute inflammation in patients [16, 18]. Previous studies have shown that the concentration of C-RP in the blood of patients undergoing laparoscopic surgery is lower than that in the OS group. In this study, the C-RP concentration after surgery in the LAS group was significantly lower than that in the open group, which proved the above results. Besides, it was also found in this study that the levels of TNF-α and IL-6 in the LAS group were significantly lower than those in the OS group (P<0.05), which was consistent with the study results of Matsubara et al. (2019) [19]. It further demonstrated the characteristics of little trauma and low risk of infection from the laparoscopic technique. CD4+ cells can participate in cell immunity, and whether CD4+/CD8+ levels are stable can reflect the immune capacity in the body. In this study, it was found that the levels of CD4+

and CD4+/CD8+ in the LAS group were significantly higher than those in the OS group (P<0.01). The CD8+ level was significantly lower than that in the OS group (P<0.01). This was consistent with the findings of Kim et al. (2019), indicating that the degree of cellular immunosuppression in patients undergoing laparoscopic surgery was lower than that in patients undergoing OS [20]. By detecting the changes in the expression of IgG and IgM in serum of patients, it was found that the expression of IgG and IgM after surgery in the LAS group was lower than that in the OS group, indicating that OS had a greater impact on the humoral immunity of patients [21].

In this study, the clinical effects of laparoscopic-assisted radical operation of gastric carcinoma and OS were discussed, which provided an experimental basis for the application of laparoscopy in the treatment of malignant tumors in the future. However, there were still some shortcomings in this study. The sample size of selected patients was small and the source was singular, which might lead to deviations of the results analysis. Moreover, the inconsistence of the surgeon's technical level would also affect the objective operation, so it is necessary to increase the sample size for multi-center research. In a word, compared with traditional OS, laparoscopic-assisted radical operation of gastric carcinoma has the advantages of reducing the risk of complications, intraoperative blood loss, patients' pain, and speeding up the recovery. It is a safe and feasible minimally invasive surgical method.

Disclosure of conflict of interest

None.

Address correspondence to: Haiping Zhao, Department of General Surgery, The First People's Hospital of Fuyang, Hangzhou 310000, Zhejiang Province, China. E-mail: zhaipkhowz86143@163.com

References

[1] Strand MS, Lockhart AC and Fields RC. Genetics of gastric cancer. Surg Clin North Am 2017; 97: 345-370.

[2] Xu Y, Jin H, Li J, Shi L, Xue H, Shuang J and Du J. Long-term outcomes of laparoscopic versus open gastrectomy for advanced gastric cancer: a large cohort study. Am J Surg 2018; 217: 750-756.

[3] Bobo Z, Xin W, Jiang L, Quan W, Liang B, Xiangbing D and Ziqiang W. Robotic gastrectomy versus laparoscopic gastrectomy for gastric cancer: meta-analysis and trial sequential analysis of prospective observational studies. Surg Endosc 2019; 33: 1033-1048.

[4] Li J, Xi H, Cui J, Zhang K, Gao Y, Liang W, Cai A, Wei B and Chen L. Minimally invasive surgery as a treatment option for gastric cancer with liver metastasis: a comparison with open surgery. Surg Endosc 2017; 32: 1422-1433.

[5] Gao Y, Xi H, Zhi Q, Li J, Zhang K, Xie T, Shen W, Cui J, Bo W and Lin C. Comparison of robotic- and laparoscopic-assisted gastrectomy in advanced gastric cancer: updated short- and long-term results. Surg Endosc 2018; 33: 528-534.

[6] Parisi A, Reim D, Borghi F, Nguyen NT, Qi F, Coratti A, Cianchi F, Cesari M, Bazzocchi F, Alimoglu O, Gagnière J, Pernazza G, D'Imporzano S, Zhou YB, Azagra JS, Facy O, Brower ST, Jiang ZW, Zang L, Isik A, Gemini A, Trastulli S, Novotny A, Marano A, Liu T, Annecchiarico M, Badii B, Arcuri G, Avanzolini A, Leblebici M, Pezet D, Cao SG, Goergen M, Zhang S, Palazzini G, D'Andrea V and Desiderio J. Minimally invasive surgery for gastric cancer: a comparison between robotic, laparoscopic and open surgery. World J Gastroenterol 2017; 23: 2376-2384.

[7] Itatani Y, Obama K, Nishigori T, Ganeko R, Tsunoda S, Hosogi H, Hisamori S, Hashimoto K and Sakai Y. Three-dimensional stereoscopic visualization shortens operative time in laparoscopic gastrectomy for gastric cancer. Sci Rep 2019; 9: 4108.

[8] Katai H, Mizusawa J, Katayama H, Morita S and Sasako M. Randomized phase III trial of laparoscopy-assisted versus open distal gastrectomy with nodal dissection for clinical stage IA/IB gastric cancer (JCOG0912). J Clin Oncol 2019; 37: 4020-4020.

[9] Kwon IG, Cho I, Guner A, Choi YY, Shin HB, Kim HI, An JY, Cheong JH, Noh SH and Hyung WJ. Minimally invasive surgery for remnant gastric cancer: a comparison with open surgery. Surg Endosc 2014; 28: 2452-2458.

[10] Iwase H, Liu H, Li T, Zhang Z, Gao B, Hara H, Wijkstrom M, Long C, Saari R and Ayares D. Therapeutic regulation of systemic inflammation in xenograft recipients. Xenotransplantation 2017; 24: e12296.

[11] Smith-Norowitz TA, Saadia TA, Norowitz KB, Joks R, Durkin HG and Kohlhoff S. Negative IgG varicella zoster virus antibody status: immune responses pre and post re-immunization. Infect Dis Ther 2017; 7: 175-181.

[12] Ojima T, Nakamura M, Hayata K and Yamaue H. Laparoscopic Roux-en-Y reconstruction us-

ing conventional linear stapler in robotic total gastrectomy for gastric cancer. Surg Oncol 2019; 33: 9-10.

[13] Katai H, Mizusawa J, Katayama H, Takagi M, Yoshikawa T, Fukagawa T, Terashima M, Misawa K, Teshima S and Koeda K. Short-term surgical outcomes from a phase III study of laparoscopy-assisted versus open distal gastrectomy with nodal dissection for clinical stage IA/IB gastric cancer: Japan Clinical Oncology Group Study JCOG0912. Gastric Cancer 2017; 20: 699-708.

[14] Pan Y, Chen K, Yu WH, Maher H and Zheng XY. Laparoscopic gastrectomy for elderly patients with gastric cancer: a systematic review with meta-analysis. Medicine 2018; 97: e0007.

[15] Kodera Y, Yoshida K, Kumamaru H, Kakeji Y, Hiki N, Etoh T, Honda M, Miyata H, Yamashita Y and Seto Y. Introducing laparoscopic total gastrectomy for gastric cancer in general practice: a retrospective cohort study based on a nationwide registry database in Japan. Gastric Cancer 2018; 22: 202-213.

[16] Kim SH, Chung Y, Kim YH and Choi SI. Oncologic outcomes after laparoscopic and open distal gastrectomy for advanced gastric cancer: propensity score matching analysis. J Gastric Cancer 2019; 19: 83-91.

[17] Ju HJ, Kim JH, Joo I, Lee S and Han JK. Transabdominal ultrasound detection of pancreatic cysts incidentally detected at CT, MRI, or endoscopic ultrasound. Ajr Am J Roentgenol 2018; 210: 1-8.

[18] Hyung WJ, Yang HK, Han SU, Lee YJ, Park JM, Kim JJ, and Kwon OK. A feasibility study of laparoscopic total gastrectomy for clinical stage I gastric cancer: a prospective multi-center phase II clinical trial, KLASS 03. Gastric Cancer 2019; 22: 214-222.

[19] Matsubara H, Kinjo Y, Fukugaki A, Iwamoto M, Ohara K, Ishino Y, Ochi S, Matsumoto T, Matsushita T and Satoh S. A novel three-step approach for secure splenectomy during laparoscopic total gastrectomy for gastric cancer. J Gastrointest Surgery 2019; 23: 1082-1083.

[20] Kim HH, Han SU, Kim MC, Kim W, Lee HJ, Ryu SW, Cho GS, Kim CY, Yang HK and Park DJ. Effect of laparoscopic distal gastrectomy vs open distal gastrectomy on long-term survival among patients with stage i gastric cancer. Jama Oncol 2019; 5: 506-513.

[21] Kano Y, Ohashi M, Ida S, Kumagai K, Nunobe S, Sano T and Hiki N. Oncological feasibility of laparoscopic subtotal gastrectomy compared with laparoscopic proximal or total gastrectomy for cT1N0M0 gastric cancer in the upper gastric body. Gastric Cancer 2019; 22: 1060-1068.