

Comparative Study on Long-term Efficacy and Safety of Laparoscopic Radical Resection and Laparotomy for Locally Advanced Gastric Cancer

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Abstract: *Objective:* To comparatively analyze the long-term efficacy and safety of laparoscopic radical resection and laparotomy for locally advanced gastric cancer, providing evidence-based medical evidence for the selection of clinical treatment plans. *Methods:* A retrospective selection of 150 patients with locally advanced gastric cancer who underwent surgical treatment in our hospital from October 2021 to October 2022 was made as the research subjects. They were divided into a laparoscopic group (120 cases) and a laparotomy group (30 cases) based on the surgical approach. The laparoscopic group underwent laparoscopic radical gastrectomy, while the laparotomy group underwent traditional laparotomy radical gastrectomy. We compared the perioperative indicators and the occurrence of postoperative complications between the two groups of patients, and conducted a 3-year follow-up to compare the 3-year overall survival rate (OS), disease-free survival rate (DFS), and tumor recurrence and metastasis between the two groups. *Results:* The intraoperative blood loss, postoperative exhaust time, postoperative hospital stay, and incision length of patients in the laparoscopic group were significantly better than those in the open surgery group (all $p < 0.001$). The operation time in the laparoscopic group was longer than that in the open surgery group ($p < 0.001$). The overall incidence of postoperative complications in the laparoscopic group was significantly lower than that in the open surgery group ($p = 0.014 < 0.05$). The 3-year overall survival (OS) and 3-year disease-free survival (DFS) rates in the laparoscopic group were higher than those in the open surgery group, while the local recurrence rate and distant metastasis rate were lower than those in the open surgery group, with no statistically significant differences between the two groups (all $p > 0.05$). *Conclusion:* Laparoscopic radical gastrectomy for locally advanced gastric cancer offers advantages such as reduced intraoperative bleeding, faster postoperative recovery, and fewer complications. Its long-term efficacy is comparable to that of open surgery. Therefore, under strict adherence to surgical indications, laparoscopic radical gastrectomy can be considered one of the preferred treatment options for locally advanced gastric cancer.

Keywords: Locally advanced gastric cancer; Laparoscopic radical gastrectomy; Open surgery; Long-term efficacy; Safety

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1. Introduction

Gastric cancer is one of the most common gastrointestinal malignancies worldwide, ranking high in both incidence and mortality rates among malignant tumors, and poses a serious threat to human life and health^[1]. In China, the incidence of gastric cancer exhibits significant regional variations, and most patients are diagnosed at the locally advanced stage,

missing the optimal opportunity for early radical treatment^[2]. Surgical resection is the core treatment for locally advanced gastric cancer. Although traditional open radical gastrectomy can effectively remove tumor tissue, it has several drawbacks, including significant surgical trauma, excessive intraoperative bleeding, slow postoperative recovery, and a high incidence of complications, all of which severely impact patients' postoperative quality of life and prognosis. With the continuous development and refinement of minimally invasive surgical techniques, laparoscopic radical gastrectomy has gradually been applied in clinical practice^[3]. Compared to traditional open surgery, laparoscopic surgery offers advantages such as clear visualization, minimal trauma, and less interference with the intraperitoneal environment, holding promise for improving patients' perioperative outcomes^[4]. However, for patients with locally advanced gastric cancer, there remains some controversy regarding whether laparoscopic surgery can achieve radical outcomes comparable to those of open surgery, particularly in terms of long-term survival rates and disease-free survival rates. This study aims to provide a more reliable basis for selecting clinical treatment plans by comparing the perioperative safety and long-term efficacy of laparoscopic radical gastrectomy with those of open surgery.

2. Materials and methods

2.1. General information

A retrospective selection was made of 150 patients with locally advanced gastric cancer who underwent surgical treatment at our hospital from October 2021 to October 2022. They were divided into a laparoscopic group (120 cases) and an open surgery group (30 cases) based on the surgical approach.

2.1.1. Inclusion criteria

- (1) Gastric cancer confirmed by gastroscopic biopsy and pathology;
- (2) Preoperative assessment via abdominal CT, ultrasound, and other examinations indicating locally advanced disease (T2-T4a, N0-N3, M0);
- (3) No surgical contraindications and ability to tolerate surgery;
- (4) Complete clinical data and willingness to cooperate in completing a 3-year follow-up.

2.1.2. Exclusion criteria

- (1) Presence of other malignant tumors;
- (2) Existence of distant metastasis;
- (3) Previous adjuvant therapy such as radiotherapy or chemotherapy before surgery;
- (4) Severe dysfunction of vital organs such as liver, kidney, or heart;
- (5) Incomplete follow-up data.

2.1.3. Study design

In the laparoscopic group, there were 78 males and 42 females, aged between 45 and 78 years, with an average age of (62.35 ± 8.42) years. Tumor locations included 35 cases in the gastric cardia and fundus, 48 cases in the gastric body, and 37 cases in the gastric antrum. Pathological types comprised 112 cases of adenocarcinoma, 6 cases of mucinous adenocarcinoma, and 2 cases of signet ring cell carcinoma. TNM staging included 52 cases in stage II and 68 cases in stage III. In the laparotomy group, there were 20 males and 10 females, aged between 48 and 76 years, with an average age of (63.12 ± 7.85) years. Tumor locations included 10 cases in the gastric cardia and fundus, 12 cases in the gastric body, and 8 cases in the gastric antrum. Pathological types comprised 28 cases of adenocarcinoma, 1 case of mucinous adenocarcinoma, and 1 case of signet ring cell carcinoma. TNM staging included 13 cases in stage II and 17 cases in stage III. There were no statistically significant differences in general data such as gender, age, tumor location, pathological type, and TNM staging between the two groups ($p > 0.05$), indicating comparability.

2.2. Surgical methods

Both groups of patients underwent routine gastrointestinal preparation, nutritional support, and symptomatic treatment before surgery, with the operations performed by the same surgical team. The laparoscopic group received general anesthesia, with the patient positioned in a supine position with the head elevated and feet lowered. A pneumoperitoneum was established, with the pressure maintained at 12–15 mmHg. An observation port was created at the umbilicus, through which a laparoscopic camera was inserted. Additionally, 3–4 operative ports were created on the left and right upper abdomen and beside the umbilicus. The abdominal cavity was explored to determine the location, size, depth of invasion, and presence of peritoneal metastasis of the tumor. Corresponding radical surgical procedures were performed based on the tumor location: proximal gastrectomy for cancer of the gastric fundus and cardia, distal gastrectomy or total gastrectomy for cancer of the gastric body and antrum. Lymph node dissection was performed according to the standards for radical gastrectomy to ensure that the dissection range met the D2 radical criteria. After the specimen was resected, it was removed through an enlarged operative port, and routine digestive tract reconstruction was performed. The abdominal cavity was irrigated postoperatively, a drainage tube was placed, and the operative ports were closed.

The open surgery group received general anesthesia, with the patient positioned supine. An incision was made through the midline of the upper abdomen or below the left costal margin, with a length of 15–20 cm. The abdominal wall layers were incised layer by layer. After exploring the abdominal cavity, the corresponding radical surgical procedures as those in the laparoscopic group were performed. Lymph node dissection was also performed according to the D2 radical criteria. Specimen resection and digestive tract reconstruction were completed, a drainage tube was placed, and the abdominal wall was sutured layer by layer.

2.3. Observation indicators

(1) Perioperative indicators

The operative time, intraoperative blood loss, postoperative flatus time, postoperative hospital stays, and incision length were recorded for both groups.

(2) Postoperative complications

Observe and record complications occurring within 30 days after surgery, including incision infection, abdominal infection, delayed gastric emptying, intestinal obstruction, hemorrhage, etc., and calculate the overall incidence of complications.

(3) Long-term efficacy

Follow up patients for 3 years using outpatient review and telephone follow-up methods to record their survival status, tumor recurrence, and metastasis.

Calculate the 3-year overall survival rate (OS) and disease-free survival rate (DFS). Recurrence is defined as local tumor recurrence or distant metastasis confirmed by postoperative imaging or pathology.

2.4. Statistical methods

Data analysis was performed using SPSS 26.0 statistical software. Measurement data are presented as mean $\pm$ standard deviation ($\bar{x} \pm s$), and comparisons between groups were made using the *t*-test. Categorical data are expressed as rates (%), and comparisons between groups were made using the χ^2 test. A *p*-value < 0.05 was considered statistically significant.

3. Results

3.1. Comparison of perioperative indicators between the two groups

The intraoperative blood loss, postoperative evacuation time, postoperative hospital stays, and incision length in the laparoscopic group were significantly better than those in the open surgery group (all $p < 0.001$); the operation time in the laparoscopic group was longer than that in the open surgery group ($p < 0.001$). See **Table 1**.

Table 1. Comparison of perioperative indicators between the two groups

Group	Operative time (min)	Intraoperative blood loss (mL)	Time to postoperative flatus (days)	Postoperative hospital stays (days)	Incision length (cm)
Laparoscopic group (n = 120)	195.68 ± 32.45	85.42 ± 21.36	2.35 ± 0.68	7.82 ± 1.53	5.26 ± 1.05
Open surgery group (n = 30)	158.36 ± 28.74	210.65 ± 45.78	3.86 ± 0.92	11.24 ± 2.16	15.68 ± 2.34
t-value	5.757	22.002	10.089	10.019	36.468
p-value	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001

Note: Compared with the laparotomy group, $p < 0.05$.

3.2. Comparison of postoperative complications between the two groups

The overall incidence of postoperative complications in the laparoscopic group was significantly lower than that in the laparotomy group ($p = 0.014 < 0.05$), as shown in Table 2.

Table 2. Comparison of postoperative complications between the two groups

Group	Incision infection	Abdominal infection	Delayed gastric emptying	Intestinal obstruction	Hemorrhage	Total incidence (%)
Laparoscopic group (n = 120)	3 (2.50)	2 (1.67)	3 (2.50)	1 (0.83)	1 (0.83)	10 (8.33)
Open Surgery group (n = 30)	4 (13.33)	2 (6.67)	1 (3.33)	0 (0.00)	1 (3.33)	8 (26.67)
χ^2	—	—	—	—	—	6.002
p-value	—	—	—	—	—	0.014

3.3. Comparison of long-term outcomes between the two groups

All patients completed a 3-year follow-up, with no lost cases. The laparoscopic group exhibited higher 3-year overall survival and disease-free survival rates, along with lower local recurrence and distant metastasis rates compared to the laparotomy group. However, the differences between the two groups were not statistically significant (all $p > 0.05$). See Table 3 for details.

Table 3. Comparison of long-term outcomes between the two groups

Group	3-Year overall survival (OS) cases (n)	3-Year OS (%)	3-Year disease-free survival (DFS) cases (n)	3-Year DFS (%)	Local recurrence cases (n)	Local recurrence rate (%)	Distant metastasis cases (n)	Distant metastasis rate (%)
Laparoscopic group (n = 120)	82	68.33	74	61.67	15	12.50	18	15.00
Open surgery group (n = 30)	19	63.33	17	56.67	4	13.33	5	16.67
χ^2	—	0.273	—	0.251	—	0.002	—	0.003
p-value	—	0.602	—	0.616	—	0.969	—	0.955

4. Discussion

The treatment of locally advanced gastric cancer primarily revolves around radical surgery. While traditional laparotomy can achieve complete tumor resection and lymph node dissection, it is associated with significant surgical trauma, substantial interference with patients' physiological functions, slow postoperative recovery, and a high incidence of

complications, all of which impact patients' postoperative rehabilitation and quality of life^[5]. With the continuous advancement of laparoscopic technology and the improvement of surgeons' operational skills, laparoscopic radical gastrectomy has gained increasing clinical application due to its minimally invasive advantages. This study compared the efficacy and safety of laparoscopic radical gastrectomy and laparotomy in the treatment of locally advanced gastric cancer, providing a reference for the selection of clinical treatment plans.

In terms of perioperative indicators, the results of this study show that the operation time in the laparoscopic group was longer than that in the open surgery group, which may be related to the relatively complex operation and long learning curve of laparoscopic surgery, as proficient surgical skills require a certain amount of time to accumulate^[6]. However, the intraoperative blood loss in the laparoscopic group was significantly less than that in the open surgery group, primarily because laparoscopic surgery provides a clear surgical field, enabling more precise identification of blood vessels and facilitating meticulous hemostasis operations, thereby reducing intraoperative bleeding^[7]. At the same time, laparoscopic surgery causes less disturbance to the intra-abdominal environment and effectively protects intestinal function. Consequently, the postoperative flatus time in patients in the laparoscopic group was significantly shortened, and the postoperative hospital stay was also correspondingly reduced, which is conducive to the rapid recovery of patients. In addition, laparoscopic surgery only requires small operative incisions, with the incision length being significantly shorter than that of open surgery, which is not only aesthetically pleasing but also reduces the risk of incision-related complications, consistent with the result in this study that the incidence of incision infection in the laparoscopic group was lower than that in the open surgery group^[8].

Postoperative complications are important factors affecting postoperative recovery and prognosis in patients. The results of this study show that the overall incidence of postoperative complications in the laparoscopic group was significantly lower than that in the open surgery group, with the incidences of incision infection and intra-abdominal infection being significantly lower in the laparoscopic group. This is because laparoscopic surgery causes less trauma, promotes faster incision healing, and involves relatively delicate intra-abdominal operations, resulting in less traction and damage to abdominal organs and a reduced risk of infection^[9]. There were no significant differences in the incidences of delayed gastric emptying, intestinal obstruction, and bleeding between the two groups, indicating that the two surgical approaches are comparable in terms of the safety of gastrointestinal reconstruction and vascular management. Delayed gastric emptying is a common complication after gastric cancer surgery, and its occurrence is related to various factors such as surgical approach, anesthesia, and the patient's overall condition. In this study, the incidence rates in the two groups were similar, suggesting that laparoscopic surgery does not increase the risk of delayed gastric emptying.

For patients with locally advanced gastric cancer, the radical nature of surgery is crucial for long-term prognosis, and the thoroughness of lymph node dissection is directly related to the radical effect of surgery. In this study, patients in both groups were followed up for 3 years, and the results showed no statistically significant differences in 3-year overall survival (OS) and 3-year disease-free survival (DFS) between the laparoscopic group and the open surgery group. Additionally, there were no significant differences in local tumor recurrence rates and distant metastasis rates between the two groups, indicating that, under strict adherence to the D2 radical resection criteria, laparoscopic surgery can achieve a radical effect comparable to that of open surgery, with reliable long-term outcomes^[10].

This study has certain limitations: Firstly, as a retrospective study, it is subject to selection bias. Although the baseline data of patients in the two groups are comparable, there may still be uncontrolled confounding factors. Secondly, the sample size is relatively limited, particularly in the open surgery group, which may affect the stability of the results. Finally, the follow-up period is relatively short, spanning only 3 years, and longer-term outcomes require further follow-up observation.

In summary, laparoscopic radical gastrectomy for locally advanced gastric cancer offers advantages such as reduced intraoperative bleeding, faster postoperative recovery, and a lower incidence of complications. Its 3-year overall survival rate and disease-free survival rate are comparable to those of open surgery, achieving satisfactory radical curative effects. Therefore, under the premise of strictly adhering to surgical indications and ensuring the radical nature of the procedure,

laparoscopic radical gastrectomy can be considered one of the preferred treatment options for locally advanced gastric cancer and is worthy of clinical promotion and application.

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Disclosure statement

The authors declare no conflict of interest.

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