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ORIGINAL ARTICLE

Therapeutic effect of laparoscopy-assisted D2 radical gastrectomy in 106 patients with advanced gastric cancer

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Summary

Purpose: *To explore the feasibility and short-term effect of laparoscopy-assisted D2 radical gastrectomy for advanced gastric cancer.*

Methods: *A total of 239 patients with advanced gastric cancer underwent D2 radical gastrectomy between March 2009 and June 2011, from which 106 patients underwent laparoscopic surgery (laparoscopy group) and 133 patients underwent open surgery (open surgery group). The intraoperative and postoperative condition, number of lymph node removed, complications and mortality rates between the two groups were compared.*

Results: *The operation time (268±51 min) and the number of lymph node removed (29.1±6.1) in the laparoscopy group were comparable with the operation time (268±49 min) and the number of lymph node removed (30.2±7.0) in the open surgery group, while there were significant differences in the intraoperative bleeding (134±66 vs 289±139 ml), intraoperative blood infusion cases (5 vs 19), time to first postoperative flatus (3.4±0.9 vs 5.0±1.4 days), time to first taking liquid food (7.3±1.3 vs 8.1±1.4 days) and postoperative hospital stay (12.8±2.6 vs 14.5±3.1 days) between the two groups ($p<0.05$). These results favored the laparoscopy group. The incidence of postoperative complications in the laparoscopy and open surgery group were 14.1 and 24.8, respectively ($p<0.05$). Compared with the open surgery, the laparoscopic surgery significantly reduced the incidence of pulmonary infection ($p<0.05$). There was no significant difference in the postoperative short-term survival rate between the two groups ($p>0.05$).*

Conclusion: *Laparoscopy-assisted D2 gastrectomy for advanced gastric cancer is advantageous in terms of safety and feasibility, rapid postoperative recovery and few complications. Both groups gave comparable results in terms of lymph node dissection and short-term survival.*

Key words: *advanced gastric cancer, gastrectomy, laparoscopy, lymph node dissection*

Introduction

Gastric cancer is a common malignancy of the gastrointestinal tract in the world. Both its incidence and mortality rates are high. The Third National Mortality Retrospective Sampling Survey showed the age-standardized mortality rate of gastric cancer in China was 30.8/100,000 in males and 13.9/100,000 in females, and ranked third in mortality among various malignancies, only second to lung and liver cancer, for which surgery still remains the treatment of choice. In 1994, Kitano et al. [1] first reported that laparoscopy-assisted radical gastrectomy had the advantages of small wound, rapid recovery, few complications and short hospital stay compared with open surgery. With advances in technology and instruments, laparoscopy-assisted radical gastrectomy has been gradually promoted around the world. In 2002, Coh et al. [2] reported laparoscopy-assisted D2 radical gastrectomy for advanced gastric cancer, which further expanded the application of laparoscopy in gastric cancer. However, laparoscopic surgery for advanced gastric cancer is still under controversy at home and abroad [3]. To explore the safety and feasibility of laparoscopic surgery for advanced gastric cancer, we summarized the laparoscopy-assisted radical gastrectomy in 106 patients with advanced gastric cancer between March, 2009 and June, 2011.

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Table 1. Clinicopathologic data; comparison between two groups

Items	*Laparoscopy group (N=106) N (%)*	*Open surgery group (N=133) N (%)*	*p-value*
Age (years) ±SD*	62.25±8.41	63±8.78	0.252
Tumor size (cm) ±SD*	4.1±2.5	4.4±2.6	0.185
T stage			0.907
T2	19 (17.92)	21 (15.79)	
T3	23 (21.70)	30 (22.56)	
T4	64 (60.38)	82 (61.65)	
N stage			0.651
N0	48 (45.28)	51 (38.35)	
N1	27 (25.47)	35 (26.32)	
N2	19 (17.92)	26 (19.55)	
N3	12 (11.32)	21 (15.79)	
Pathology			0.484
Differentiated	45 (42.45)	55 (41.35)	
Non-differentiated	61 (57.55)	78 (58.65)	
Surgical method			0.377
Distal gastrectomy	22 (20.75)	31 (23.31)	
Total gastrectomy	84 (79.25)	102 (76.69)	

*age and tumor size were analyzed using t-test; other values were analyzed with chi-square test. SD: standard deviation

Methods

Patient data

A total of 239 patients with advanced gastric cancer underwent D2 radical gastrectomy in the First Hospital of Putian between March, 2009 and June, 2011. Using retrospective non-randomized controls, all patients were separated into two groups: 106 patients in the laparoscopy group and 133 patients in the open surgery group. TNM staging was assessed according to the 7th edition of the UICC and standard D2 radical gastrectomy was carried out based on grouping and sub-station and the range of the dissected lymph nodes according to the Japanese Classification of Gastric Carcinoma (14th edition). Clinicopathological data in the two groups were comparable (Table 1).

Inclusion/exclusion criteria

Inclusion criteria included: 1) Age 50-80 years; 2) Good preoperative cardiopulmonary function; 3) Definite gastric cancer diagnosis; 4) No retroperitoneal and para-aortic enlarged lymph nodes during preoperative work up, with pancreas, liver, colon and other organs not invaded, and no liver, lung and abdominal pelvic metastasis; and 5) No pelvic cavity implants in digital rectal examination.

Exclusion criteria included extensive abdominal metastases under laparoscopic exploration; or serosa area invaded more than 10 cm2; or tumor diameter more than 10 cm.

Procedures

Laparoscopic D2 gastrectomy

Under general anesthesia patients were placed in a 10°-20° head-up position with legs apart. The operating table was positioned as low as possible. In this technique the surgeon sits on the left of patient, the assistant on the right of patient and the laparoscope holder sits between the patient's legs. Using the 5-hole method, CO2 pneumoperitoneum was established by puncturing below the umbilicus and then a 10 mm trocar was inserted as an inspection hole. Laparoscope was advanced into the abdominal cavity through the inspection hole of the umbilical region for routine exploration, with particular attention as to whether there was obvious metastasis in the liver, abdominal cavity and greater omentum and defining tumor location and whether the serosa was invaded. A 12 mm trocar inserted from the anterior axillary line below the left costal border was the main operating hole, while 5 mm trocars inserted from the left of the mid-clavicular line at the umbilical level, medioclavicular line below the right costal margin and anterior axillary line below the right costal margin were auxiliary operating holes. Surgical procedures were carried out according to area division.

Radical distal gastrectomy

The procedures were as follows: subpyloric area→above/pancreas lesser gastric curvature→greater gastric curvature near the splenic flexure to explore the abdominal and pelvic cavity, and locate the tumor. 1) Subpyloric area: dissecting the greater omentum along the margin of transverse colon using ultrasound knife, stripping upward the anterior lobe of the transverse mesocolon to expose the inferior margin of the pancreas and the surface of the head of pancreas, exposing as well the right gastroepiploic artery and vein and removing No.6 as well as No.4 lymph nodes; 2) Above the pancreas area: exposing the superior margin of pancreas, incising the gastropancreatic ligament, dissecting the iliac axis, common hepatic artery , left gastric artery and proximal splenic artery, dividing the left gastric vessels, posterior gastric vessels, sweeping No.7, No.8a, No.9 and No.11p lymph nodes, exposing the gastroduodenal artery and arteria hepatica propria rightward, fully separating the duodenum to 3-5 cm of the subpyloric area to expose the right gastric vessels, dividing the right gastric vessel and sweeping No.12a

and No.5 lymph nodes; 3) Lesser gastric curvature: dividing the hepatogastric ligament near the inferior liver border, exposing the lesser gastric curvature from the middle of lesser gastric curvature to the right of the cardia and sweeping No.1 and No.3 lymph nodes; 4) Greater gastric curvature near the splenic flexure: turning stomach headward to reveal the left gastroepiploic vessels in the pancreatic tail, sweeping No.4sb lymph nodes and breaking 1-2 pairs of the short gastric vessels. We performed an incision of 5-7 cm in the middle of the upper abdomen, protected the incision, brought the stomach outside the incision to complete anastomosis of the digestive tract (Billroth I or Billroth II anastomosis) and closed the abdomen after routine placement of drainage tube. The sequence of lymph node dissection: No.6, No.4d→No.7,No.9, No.11p→No.8a, No.12a, No.5→No.3, No.1→No.4sb).

Radical total gastrectomy

Radical total gastrectomy was performed as follows: subpyloric area→above pancreas area→lesser gastric curvature procedures were similar to radical subtotal gastrectomy. Hilum of spleen: dividing the left gastroepiploic vessels exposed in the pancreatic tail, sweeping No.4sb lymph node, exposing the splenic artery and vein, hilus of spleen, poles vessels and splenic lobar vessels along the root of the left gastroepiploic veins, dividing short gastric vessels and sweeping No.10 and No.11d lymph nodes. Left of cardia: separating the gastrophrenic ligament upward to the left of the cardia, sweeping No.2 lymph nodes, exposing the diaphragmatic hiatus, and separating the lower part of esophagus about 6-8 cm and clipping as well as dividing duodenum with linear cutting staplers. An incision about 6-8 cm just below the xiphoid process was performed. We protected the incision, divided esophagus, took out the stomach, performed Roux-Y anastomosis with stapler and closed the abdomen after routine placement of drainage tube.

The sequence of lymph node dissection: No.6, No.4d→No.7, No.9, No.11p→No.8a, No.12a, No.5→No.3, No.1→No.4sb→No.10, 11d→No.2).

The above mentioned sequences of lymph node dissection were carried out according to the area division, which avoided frequent turns of surgical position, reduced repeated turns of the invaded stomach wall, and provided good surgical field exposure for surgical cooperation and consistency. It could also make the tissue required to be separated from bottom to top, thus we could follow up the principle of en bloc resection as much as possible.

Statistics

All data were analyzed using SPSS 19.0 software for Windows (Chinese version). Measurement data were expressed as mean ±SD. T-test was used for comparison of means and chi-square test for enumeration data. A p-value $p<0.05$ was considered statistically significant.

Table 2. Comparison of intraoperative and postoperative conditions (mean ± standard deviation)

Conditions	*Laparoscopy group (N=106)*	*Open surgery group (N=133)*	*p-value*
Operation time (min)	268±51	261±49	0.142
Amount of bleeding (ml)	134±66	289±139	0.000
Intraoperative blood transfusion	5	19	0.000
Number of dissected lymph nodes	29.1±6.1	30.2±7.0	0.100
Time to postoperative flatus (days)	3.4±0.9	5.0±1.4	0.000
Time to first taking liquid diet (days)	7.3±1.3	8.1±1.4	0.000
Postoperative hospital stay (days)	12.8±2.6	14.5±3.1	0.000

Results

Comparison of intraoperative and postoperative conditions

There were no significant differences in the operation time and the number of lymph nodes removed between the laparoscopy and the open surgery group ($p>0.05$), while the amount of intraoperative bleeding, intraoperative blood transfusion cases, time to postoperative flatus, time to first taking liquid food, postoperative hospital stay and intraoperative as well as postoperative recovery items favored significantly the laparoscopy group ($p<0.05$) (Table 2).

Three cases in the laparoscopy group converted to open surgery, so the rate of converting to open surgery was 3%. One patient converted to open surgery because the posterior wall of the stomach was invaded and hardly distinguished from the pancreas. The second patient had relatively large No.7, No.8 and No.11 lymph nodes which were partly fused, encircled vessels and were hard to dissect. The third patient converted to open surgery because of uncontrolled bleeding.

Complications

Complications occurred in 15 (14.1%) patients of the laparoscopy group and in 33 (24.8%) pa-

Table 3. Comparison of postoperative complications between the two groups

Complications	*Laparoscopy group (N=106) N (%)*	*Open surgery group (N=133) N (%)*	*p-value*
Total numbers of complications	15 (14.15)	33 (24.81)	0.029
Surgical complications	11 (10.38)	18 (13.53)	0.295
Anastomotic leakage	1 (0.94)	1 (0.75)	
Duodenal fistula	0 (0)	0 (0)	
Intestinal obstruction	1 (0.94)	3 (2.26)	
Anastomotic stenosis	1 (0.94)	2 (1.5)	
Anastomotic bleeding	1 (0.94)	1 (0.75)	
Incision infection	1 (0.94)	3 (2.26)	
Abdominal cavity infection	1 (0.94)	2 (1.50)	
Remnant stomach weakness	2 (1.88)	2 (1.50)	
Pancreatic fistula	1 (0.94)	1 (0.75)	
Lymphatic fistula	2 (1.88)	2 (1.50)	
Non-surgical complications	4 (3.77)	15 (11.28)	0.027
Pulmonary infection	3 (2.83)	13 (9.77)	
Cardiovascular disease	1 (0.94)	2 (1.50)	
In-hospital mortality	0 (0)	0 (0)	

tients of the open surgery group (p=0.027; Table 3). The incidence of pulmonary infection in the laparoscopy group was significantly less than that in the open surgery group (3 vs 13; p<0.05), indicating that laparoscopic surgery could significantly reduce the incidence of pulmonary infection.

Follow-up

Until September, 2011, the median follow-up time of the two groups was 15 months (range 3-30). Of 239 patients, 11 were lost to follow-up (228/239; follow-up rate 92.09%) and 227 cases survived. Of 128 cases in the open surgery group 127 (99.3%) followed-up patients survived and 1 case died of liver metastasis. All of the 100 cases in the laparoscopy group survived (100%). There was no significant difference in the postoperative short-term survival rate between the two groups (p>0.05).

Discussion

Laparoscopic surgery for gastric cancer has obvious advantages such as minimal wound in the treatment of early gastric cancer and short-term and long-term therapeutic effect comparable with open surgery. Fujiwara et al. [4] reported that the 5-year overall survival rate of 94 patients with early gastric cancer undergoing laparoscopy-assisted radical gastrectomy between 1998 and 2002 was 90%. Japanese researchers [5] published the results of multicenter large (n=1294) trials on laparoscopic surgery for early gastric cancer, which showed a recurrence rate of only 0.6% (median follow-up time 36 months, range 13-113). The 5-year overall survival of stages, IA,IB and II patients was 99.8, 98.7 and 85.7% respectively, indicating that laparoscopic surgery is highly efficacious in early gastric cancer. In China, the diagnosis of early gastric cancer is low because of massive population and the low rate of gastroscopies; as a result, about 90% of patients have advanced gastric cancer at diagnosis [6,7]. Thus, in China laparoscopy is mainly used for advanced gastric cancer, which is a question to be tackled at present and in the coming years and also a development direction. Recently, laparoscopy-assisted radical gastrectomy has developed rapidly from use in early gastric cancer to some of advanced gastric cancer cases.

Our study showed that laparoscopy for advanced gastric cancer had several advantages including small wound, rapid postoperative recovery, and few complications, compared with conventional open surgery, and the laparoscopy group obviously surpassed the open surgery group regarding time to postoperative first flatus, time to first taking liquid food and postoperative hospital stay. The incidence of postoperative complications in the laparoscopy group vs the open surgery group was 14.1 and 24.8%, respectively (p<0.05). We deemed that laparoscopy would obviously limit the operation wound to only some small holes and an incision of 5-7cm. Moreover, the procedures we used were based on the area module that decreased repeated turns of the involved gastric wall and had less interference on organs and tissues of the abdominal cavity, which reduced the postoperative intestinal adynamic ileus, abdominal infection and other complications. With regard to laparoscopic surgery for advanced gastric cancer, anastomosis is a difficult task be-

cause of small incision, deep anastomostic site and limited visual field as well as space, usually leading to tear in the anastomosis and anastomotic bleeding. We summarized some techniques on anastomosis through our exploration. First, a small automatic draw hook was placed on the left and 10°-20° right oblique position of bed, which provided good visual field for anastomosis. Second, after the anastomosis reached the distal jejunum and penetrated the lateral jejunal wall, a rubber band was used to fix the anastomosis with jejunum; then, esophageal-jejunal anastomosis was performed followed by excision and pull-out, which effectively solved problems caused by the limited operation space, such as anastomotic prolapse, jejunum overlapping and so on. Third, routine strengthening on anastomosis by 4 stitches at front, back, left and right effectively reduced anastomotic fistula formation and anastomotic bleeding. Fourth, embedding of duodenal stump reduced the incidence of duodenal stump leakage. In addition, the incidence of pulmonary infection was significantly reduced in the laparoscopy group compared with the open surgery group ($p<0.05$), which could be attributed to easy postoperative cough and relatively early out-of-bed activity. There are few reports on laparoscopic surgery for advanced gastric cancer in recent years, among which Huang et al. [8] reported that laparoscopic radical gastrectomy didn't increase operation complications and mortality compared with open surgery.

A randomized controlled study (HCOG 9501) confirmed that tumor prognosis was not improved by para-aortic lymph node dissection [9]. The Japanese Classification of Gastric Carcinoma (14th edition) considers that D2 radical gastrectomy is enough to advanced gastric cancer. Our study showed that laparoscopy-assisted D2 radical gastrectomy for advanced gastric cancer was safe and feasible and its results on lymph node dissection were comparable with open surgery. The number of lymph nodes removed is a major issue in evaluating the therapeutic effect of lymph node dissection. We found that the number of the excised lymph nodes in the laparoscopy group (29.1±6.1) was comparable with those in the open surgery group (30.2±7.0; $p>0.05$). Laparoscopy-assisted gastrectomy performed by experienced surgeons and fine anatomic layering under laparoscopic visual field are key factors for successful lymph node dissection. Sight amplification by laparoscope can exhibit more subtle vessels, nerves, fascia and other structures, which is quite heipful to dissociate in space, to reduce bleeding and open the vascular sheath for more complete lymph node dissection. Moreover, lymph node dissection was performed based on area module, which was favorable for teamwork and ensured the feasibility of D2 radical gastrectomy for advanced gastric cancer. Recently, some relevant reports, such as Tanimura et al. [10] retrospectively analyzed 235 patients who had undergone laparoscopic D2 radical gastrectomy and 200 patients with open surgery and showed that the average number of lymph nodes removed in the 2 groups were 31 and 30, respectively, with no significant difference. We believe that laparoscopic gastric surgery can completely replace open surgery in lymph node dissection.

We also assessed the postoperative short-term survival of the two groups, which showed no significant difference ($p>0.05$). However, because the median follow-up time was relatively short (15 months; range 3-30), long-term prognosis remains to be evaluated. There are relevant reports on the prognosis of laparoscopic surgery for advanced gastric cancer. Huscher et al. [11] reported that of 59 patients 30 were randomly selected to undergo laparoscopic surgery and 29 to open surgery. In the laparoscopic and open surgery groups included were 17 and 20 cases with advanced gastric cancer, respectively. The results showed 5-year overall survival rates in the laparoscopy group and open surgery group were 55.7 and 58.9%, respectively, and disease-free survival rates were 54.8 and 57.3%, respectively, without statistical difference. Hur et al. [12] reported that with regard to advanced gastric cancer invading subserosa, laparoscopic surgery could produce comparable 3-year overall survival and 3-year disease-free survival. Shuang et al. [13] carried out a controlled trial on laparoscopic surgery and open surgery with a median follow-up of 36 months and showed no significant difference in total survival rate between the two groups.

The Chinese Laparoscopic Gastrointestinal Surgery Study group (CLASS) was established in November 2009, with 31 participating centers. In a multicenter, retrospective, case-control study on laparoscopic and open surgery for radical gastrectomy carried out by CLASS in 2010, no significant difference was found in operation complications and short-term oncology curative effects between laparoscopic and open surgery groups. Considering excessive cases and high percentage of patients with advanced gastric cancer in China, CLASS plans to carry out our own multicenter

randomized controlled clinical trial on the oncological curative effect of laraposcopic and open surgery D2 radical gastrectomy for advanced gastric cancer (CLASS-01 trial). Meanwhile, Japan and Korea are conducting multicenter studies on laparoscopic surgery for advanced gastric cancer.

In conclusion, laparoscopy-assisted D2 radical gastrectomy for advance gastric cancer has advantages such as safety, feasibility, rapid postoperative recovery and few complications. It can also produce similar results with open surgery such as lymph node dissection and short-term survival. However, further studies on laparoscopy-assisted radical gastrectomy for advanced gastric cancer are required. Laparoscopy-assisted D2 gastrectomy can successfully be performed by experienced teams. However, long-term survival, recurrence and other therapeutic effects, about which people are concerned are still to be verified in large well-designed prospective trials.

References

1. Kitano S, Iso Y, Moriyama M, Sugimachi K. Laparoscopy-assisted Billroth I gastrectomy. Surg Laparosc Endosc 1994; 4: 146-148.
2. Goh PM, Khan AZ, So JB et al. Early experience with laparoscopic radical gastrectomy for advanced gastric cancer. Surg Laparosc Endosc Percutan Tech 2001; 11: 83-87.
3. Oida T, Kano H, Mimatsu K et al. Technical considerations in laparoscopic staging for advanced gastric cancer. Hepatogastroenterology 2012; 59: 164-167.
4. Fujiwara M, Kodera Y, Misawa K et al. Long term outcomes of early-stage gastric carcinoma patients treated with laparoscopy-assisted surgery. J Am Coll Surg 2008; 206: 138-143.
5. Kitano S, Shiraishi N, Uyama I, Sugihara K, Tanigawa N. Japanese Laparoscopic Surgery Study Group. A multicenter study on oncologic outcome of laparoscopic gastrectomy for early cancer in Japan. Ann Surg 2007; 245: 68-72.
6. Xia YJ, Ma YY, He XJ, Wang HJ, Ye ZY, Tao HQ. Suppression of selenium-binding protein 1 in gastric cancer is associated with poor survival. Hum Pathol 2011; 42: 1620-1628.
7. Lambert R. Endoscopy in screening for digestive cancer. World J Gastrointest Endosc 2012; 4: 518-525.
8. Huang JL, Wei HB, Zheng ZH el al. Laparoscopy-assisted D2 radical distal gastrectomy for advanced gastric cancer. Dig Surg 2010; 27: 291-296.
9. Sasako M, Sano T, Yamamoto S et al. D2 lymphadenectomy alone or with para-aortic nodal dissection for gastric cancer. N Engl J Med 2008; 359: 453-462.
10. Tanimura S, Higashino M, Fukunaga Y et al. Laparoscopic distal gastrectomy with regional lymph node dissection for gastric cancer. Surg Endosc 2005; 19: 1177-1181.
11. Huscher CG, Mingoli A, Sgarzini G et al. Laparoscopic versus open subtotal gastrectomy for distal gastric cancer; five-year results of a randomized prospective trial. Ann Surg 2005; 241: 232-237.
12. Hur H, Jean HM, Kim W. Laparoscopy-assisted distal gastrectomy with D2 lymphadenectomy for T2b advanced gastric cancers: three years' experience. J Surg Oncol 2008; 98: 515-519.
13. Shuang J, Qi S, Zheng J et al. A case-control study of laparoscopy-assisted and open distal gastrectomy for advanced gastric cancer. J Gastrointest Surg 2011; 15: 57-62.