RESEARCH ARTICLE

Analysis of Laparoscopy-assisted Gastric Cancer Operations Performed by Inexperienced Junior Surgeons

Xing-Mao Zhang, Zheng Wang, Jian-Wei Liang, Zhi-Xiang Zhou*

Abstract

To clarify whether gastric cancer patients can benefit from laparoscopy-assisted surgery completed by junior surgeons under supervision of expert surgeons, data of 232 patients with gastric cancer underwent operation performed by inexperienced junior surgeons were reviewed. Of the 232 patients, 137 underwent laparoscopy-assisted resection and in 118 cases this approach was successful. All of these 118 patients were assigned to laparoscopic group in this study, 19 patients who were switched to open resection were excluded. All laparoscopic operations were performed under the supervision of expert laparoscopic surgeons. Some 95 patients receiving open resection were assigned to the open group. All open operations were completed independently by the same surgeons. Short-term outcomes including oncologic outcomes, operative time intra-operative blood loss, time to first flatus, time to first defecation, postoperative hospital stay and perioperative complication were compared between the two groups. The numbers of lymph nodes harvested in the laparoscopic and open groups were21.1±9.6 and 18.2±9.7 (p=0.029). There was no significant difference in the length of margins. The mean operative time was 215.9±32.2 min in laparoscopic group and 220.1±34.6min in the open group (p=0.866), and the mean blood loss in laparoscopic group was obviously less than that in open group (200.9±197.0ml *vs* 291.1±191.4ml; p=0.001). Time to first flatus in laparoscopic and open groups was 4.0±1.0 days and 4.3±1.2days respectively and the difference was not significant (p=0.135). Similarly no statically significant difference was noted for time to first defecation (4.7±1.6 *vs* 4.8±1.6, p=0.586). Eleven patients in the laparoscopic group and 19 in the open group suffered from peri-operative complications and the difference between the two groups was significant (9.3% *vs* 20.0%, p=0.026). The conversion rate for laparoscopic surgery was 13.9%. Patients with gastric cancer can benefit from laparoscopy-assisted operations completed by inexperienced junior surgeons under supervision of expert laparoscopic surgeons.

Keywords: Junior surgeon - laparoscopy-assisted resection - open resection - gastric cancer - short-term outcome

Asian Pac J Cancer Prev, **15 (12)**, 5077-5081

Introduction

Health and life of Asian is threatened by gastric cancer seriously (Atrkar-Roushan et al., 2013; Unal et al., 2014). Technique of laparoscopy-assisted gastric cancer resection was reported by Kitano et al in 1994 firstly (Kitano et al., 1994). From then on, this technique has been accepted by surgeons and patients gradually and the advantages of this approach have been confirmed by several centers (Kim et al., 2012; Shinohara et al., 2013; Sakuramoto et al., 2013; Haverkamp et al., 2013; Liao et al., 2013). While emphasis too much on the advantages of laparoscopic resection, learning itself usually be ignored. Whether every surgeon can perform this approach perfectly? Whether laparoscopic operation performed by inexperienced junior surgeons can get satisfactory results? Aimed at finding answers for these questions, a study was designed by us to compare the different outcomes of laparoscopy-assisted gastric cancer resection performed by inexperienced junior surgeons under the supervision of expert laparoscopic surgeons and open resection completed by the same surgeons.

Materials and Methods

Population

Data of patients underwent gastric cancer operation completed by six junior surgeons from May 2011 to March 2013 in cancer hospital, Chinese academy of medical sciences were collected and analyzed retrospectively. Preoperative definite diagnosis for each patient was confirmed by gastroscope with biopsy. Upper gastrointestinal radiography, abdominal computed tomography scan and abdominal ultrasound were routinely used for evaluation. Distance metastasis was excluded by imaging examination.

All these 6 junior surgeons who had no enough laparoscopic experience were surgical oncologists.

*Department of Gastrointestinal Surgery, Cancer Hospital, Chinese Academy of Medical Sciences, Peking Union Medical College, Beijing, China *For correspondence: zhouzx_01@163.com*

Before launching laparoscopic-assisted gastric cancer resection, 2 surgeons had no experience of laparoscopy-related operation and 4 surgeons had experienced a few laparoscopic operations such as laparoscopic-assisted colorectal cancer resection. All of them had open surgery experience for about 5 years and each surgeon had completed about 30 gastric cancer operations independently.

Choice of the surgical procedure (laparoscopic versus open) was strictly based on the patient's individual decision after providing informed consent concerning the methods and risks of each procedure. The protocol was approved by the ethics committee of our hospital. According to the Japanese Classification of Gastric Carcinoma (Hwang et al., 2009), extended lymph node dissection (D2) was the preferred procedure in both laparoscopic resection and open resection (Table 1). We were used to performing D1+ lymphadenectomy for older and high-risk patients aimed at reducing intra-operative risk and postoperative complications.

In our study, consecutive patients received laparoscopy-assisted gastric cancer resection successfully were assigned to laparoscopic group and patients received open surgery concurrently were assigned to open group. Short-term outcomes including operative time, intra-operative blood loss, conversion rate, number of lymph nodes harvested, time to first flatus, time to first defecation, intra- and postoperative complications were compared between the two groups.

Laparoscopic technique

All patients were placed in lithotomy position. Five trocars were used in all patients, a 12mm port below the umbilicus was created to introduce the laparoscope, another 12 mm trocar was introduced into the left anaterior axillary line 2cm below arch of rib, a 5mm trocar was insert in the port of paraumbilical midclavicular line, another two 5mm trocars were placed in the corresponding position of right abdomen. The operator stood on the left side of the patient.

A routine exploration of the abdominal and pelvic cavity was performed, separation of the greater omentum from the transverse colon was started from the middle and continued rightward to the hepatic flexure, and the superior leaf of the mesocolon was resected. According to the tumor location combined with tumor size and pathologic type, selective ligation of peripheral vascular of stomach including the right gastroepiploic vessel, left gastroepiploic vessel, left gastric vessel, right gastric vessel and vasa brevia and dissection of lymph nodes of draining area were performed in proper sequence under laparoscopy, then the duodenum or/and distal esophagus was transected through the small incision which was done when laparoscopic procedure was completed, and the stomach was transected or total stomach was removed. Soon afterwards, billrothI, billrothII, esophago-gastrostomy, double "S" or Roux-en-Y anastomosis was performed according to the extent of resection. Gastrointestinal decompression tube and abdominal cavity drainage tube were indwelled routinely.

All laparoscopic-assisted operations were completed under supervision of expert laparoscopic surgeons and all open operations were completed by junior surgeons independently in this study.

Statistical analysis

Statistical analyses were performed using statistical software package SPSS version 16.0. A P-value less than 0.05 was considered to be statistically significant. Categorical variables were analyzed by Chi-square test, and continuous variables were analyzed by the Student's t test.

Results

A total of 137 patients were attempted to deliver laparoscopy-assisted gastric cancer resection. 118 patients underwent this approach successfully were assigned to laparoscopic group. 19 patients were converted to open surgery and they were excluded from analysis. 95 patients underwent open surgery were assigned to open group.

Clinical and pathological findings

Age, gender, concomitant diseases, BMI, ASA, abdominal operation history and operation type were matched between the two groups (Table 1). The mean tumor size was 4.8±2.4 cm in laparoscopic group and 4.1±2.2 cm in open group (p=0.060). In laparoscopic group, 75 patients underwent distal gastrectomy with BillrothIanastomosis, 17 patients underwent distal

Table 1. Comparisons of Two Groups for General Parameters

Parameters	Laparoscopic group (n=118)	Open group (n=95)	p value
Gender			0.268
Male	80	71	
Female	38	24	
Age, year (mean±SD)	55.2±12.6	54.0±10.1	0.47
BMI, kg/m^2(mean±SD)	23.4±3.5	24.0±3.4	0.226
ASA			0.096
I	17	6	
II	83	78	
III	18	11	
Concomitant diseases			0.942
Yes	33	27	
No	85	68	
Abdominal operation history			0.208
Yes	18	9	
No	100	86	
Tumor size, cm(mean±SD)	4.8±2.4	4.1±2.2	0.06
Resection			0.914
Distal gastrectomy	92	74	
Proximal gastrectomy	12	11	
Total gastrectomy	14	10	
Lymphadenectomy			0.753
D1+	18	16	
D2	100	79	
Reconstruction			0.514
BillrothI	75	59	
BillrothII	17	15	
Esophago-gastrostomy	12	11	
Double "S"	14	8	
Roux-en-Y	0	2	

gastrectomy with BillrothIIanastomosis, 12 patients underwent proximal gastrectomy with esophago-gastrostomy anastomosis, 14 patients underwent total gastrectomy with Double "S" anastomosis; In open group, 59 patients underwent distal gastrectomy with BillrothIanastomosis, 15 patients underwent distal gastrectomy with BillrothIIanastomosis, 11 patients underwent proximal gastrectomy with esophago-gastrostomy anastomosis and 8 patients underwent total gastrectomy with Double "S" anastomosis and and 2 patients underwent total gastrectomy with Roux-en-Y anastomosis (Table 1). 18 patients underwent D1+ lymphadenectomy and 100 patients experienced D2 lymphadenectomy in laparoscopic group, and 16 patients received D1+ lymphadenectomy and 79 patients received D2 lymphadenectomy in open group, the difference was not obvious.

Comparisons of pathological outcomes including T-classification, number of lymph node harvested, tumor differentiation, pathological type of tumor, length of distal or/and proximal margin between the two groups were shown in Table 2.

Operative results and recovery of intestinal function
The mean operative time was 215.9±32.2min in laparoscopic group and 220.1±34.6min in open group (p=0.866), and the mean blood loss in laparoscopic group was obviously less than that in open group (200.9±197.0ml *vs* 291.1±191.4ml; p=0.001). Time to passing of first flatus was similar between the two groups (Laparoscopic group *vs* Open group: 4.0±1.0 days *vs* 4.3±1.2 days; p=0.135), and the same result could be found for the time to passing of first defecation (Laparoscopic group *vs* Open group: 4.7±1.6 days *vs* 4.8±1.6 days; p=0.586). Time to resumed soft diet in laparoscopic group was a little earlier than in open group although no statistical significance (7.2±1.3 days *vs* 7.4±1.5 days; p=0.454). The hospital stay in laparoscopic group was significantly shorter than that in open group (10.2±2.3 days *vs* 11.0±2.9 days; p=0.025), all of results were shown in Table 3.

Table 2. Comparisons between the Two Groups for Pathological Outcomes

Outcomes	Laparoscopic group (n=118)	Open group (n=95)	*P*-value
T-classification			0.32
T1	21	18	
T2	27	13	
T3	45	45	
T4	25	19	
Number of lymph node harvested(mean±SD)			
	21.1±9.6	18.2±9.7	0.029
Tumor differentiation			0.899
Well	6	4	
Moderate	18	13	
Poor	94	78	
Pathology			0.287
adenocarcinoma	85	74	
Signet ring cell	33	21	
Length of margin for distal gastrectomy			
Distal margin, cm(mean±SD)	3.0±0.4	2.9±0.4	0.236
Proximal margin, cm(mean±SD)	5.3±0.5	5.3±0.6	0.828
Length of margin for proximal gastrectomy			
Distal margin, cm(mean±SD)	5.2±0.5	5.1±0.6	0.545
Proximal margin, cm(mean±SD)	3.2±0.4	3.1±0.4	0.258

Complication and conversion

The complication rate in laparoscopic group was lower than that in open group (9.3% *vs* 20.0%, p=0.026). In laparoscopic group, six patients had complications including fat liquefaction (n=4) and infection (n=2); two patients had anastomosis leakage: one had gastroduodenal anastomosis leakage and one had gastrojejunal anastomosis leakage, both of them were cured by indwelling drainage tube and washout; two patients had intraperitoneal hemorrhage which was cured by using hemostatic and transfusion; one patients had gastroplegia and it was cured by indwelling jejunum nutrition tube and jejunal infusion of nutrition. In open group, fourteen patients had incision complication including fat liquefaction (n=11) and infection (n=3); one patient had gastroduodenal anastomosis leakage; two patients had intraperitoneal hemorrhage; two patients had gastroplegia. Treatments of these complications were similar to what mentioned in laparoscopic group (Table 3). The conversion rate was 13.9% (19/137) for laparoscopy-assisted resection in our study. Reasons for conversion showed in table 4 including unclear anatomy, intra-operative bleeding, abdominal

Table 4. Reasons for Conversion

Reasons for conversion	Number of patients (n=19)
Bleeding (%)	4 (21.0%)
Adhesion (%)	4 (21.0%)
Adjacent structure invasion (%)	3 (15.8%)
Bulky mass (%)	3 (15.8%)
Unclear anatomy (%)	3 (15.8%)
Obesity (%)	2 (10.5%)

Table 3. Comparisons between the two Groups for Operative Outcomes and Postoperative Recovery

Outcomes	Laparoscopic group (n=118)	Open group (n=95)	*P*-value
Operative time, min (mean±SD)	215.9±32.2	220.1±34.6	0.866
Blood loss, ml (mean±SD)	200.9±197.0	291.1±191.4	0.001
Time to first flatus, day (mean±SD)	4.0±1.0	4.3±1.2	0.135
Time to first defecation, day (mean±SD)	4.7±1.6	4.8±1.6	0.586
Time to resumed soft diet, days (mean±SD)	7.2±1.3	7.4±1.5	0.454
Hospital stay, day (mean±SD)	10.2±2.3	11.0±2.9	0.025
Peri-operative complication	11	19	0.026
Incision complication	6	14	0.016
Anastomosis leakage	2	1	0.693
Intraperitoneal hemorrhage	2	2	0.826
Gastroplegia	1	2	0.439
Length of incision, cm (mean±SD)	6.9±0.8	14.0±1.0	<0.001

cavity adhesion, adjacent structure invasion, obesity and bulky mass (Table 4).

Discussion

With the development of laparoscopic instruments and the accumulation of surgical technique, laparoscopy-assisted gastrectomy occupies an important position in field of surgical treatment for gastric cancer (Zhao et al., 2013; Qiu et al., 2013; Jiang et al., 2013). Several advantages of this approach have been reported by different centers. Not only cosmetic effect but the less pain, rapider recovery, lower complication rate and shorter hospital stay attract much attention when compared with open resection (Lee et al., 2013; Nakamura et al., 2013; Jeong et al., 2013). Laparoscopy-assisted resection with D1 lymphadenectomy for early gastric cancer has received encouraged results (Lee et al., 2013); meanwhile, for advanced gastric cancer, laparoscopy-assisted resection with D2 lymphadenectomy has been recommended as standard procedure by some authors (Shim et al., 2013; Hur et al., 2013; Lin et al., 2013).

Controversies still exist although most of reports attempt to draw a conclusion that laparoscopy-assisted resection is a feasible and safe approach for gastric cancer (Lee et al., 2013), and it is not difficult to find that expert surgeons who had experienced laparoscopic skill and had completed a large number of laparoscopic operations before were mentioned frequently to complete the procedure of laparoscopy-assisted gastric cancer resection when we have the honor to read the related papers (Nakamura et al., 2013; Shim et al., 2013; Hur et al., 2013). A question whether patients can benefited from laparoscopic resection performed by junior surgeons who have not enough laparoscopic experience should be answered. So, we designed this study with a view to answering this question.

Oncologic outcomes in our study showed that length of distal and proximal margin in laparoscopic group met the standard of recommended (Hallet et al. 2013), and there was no statistically significant difference between two groups, lymph nodes retrieved in laparoscopic group was obviously more than that in open group. Several factors have influence on the number of lymph nodes harvested. Except for the influence factors of patients themselves and pathologist, the amplification of laparoscopy and clear view might be two factors which could not be ignored. Operative time of laparoscopic resection was not prolonged compared with open operation and the intra-operative blood loss was obviously less in laparoscopic group than that in open group. Anatomy under laparoscopy had a lot of differences when compared with that observed under direct vision. However, under supervision of expert laparoscopic surgeons, a junior surgeon without enough laparoscopic experience had no difficulty to distinguish the anatomic structure and to judge the anatomic plane accurately.

Rapider gastrointestinal recovery of patients underwent laparoscopic surgery has been reported previously, reasons included that: first, the intra-abdominal organs have the chance to avoid contacting the external environment so that the disturbance for internal environment of patients was slight. Second, gastrointestinal tract was pulled slightly during the procedure of laparoscopic operation (Akiyoshi et al., 2009). Compared with open surgery, earlier intestinal function recovery had been found in our study.

Conversion rate in our study was a little higher than results which had reported previously by some centers (Chen et al., 2012; Wan et al., 2012). For example, a study designed by Toshihiko Shinohara et al (2013) showed that the conversion rate in their laparoscopic group was 2.2% (4/186). The most common reasons for conversion in our study were bleeding and adhesion. Unskilled operation and the lack of experience might be the main reasons although under supervision of expert laparoscopic surgeons.

Results including the similar operative time, less intra-operative blood loss, lower complication rate and rapider intestinal function recovery in our study had confirmed the advantages of laparoscopic resection performed by junior surgeon under supervision of expert laparoscopic surgeons. Patients benefited from laparoscopic resection in our study. We thought that junior surgeons who have no enough laparoscopic experience could perform laparoscopic gastric cancer resection satisfactorily under the supervision of expert laparoscopic surgeons.

Laparoscopic surgery requires specialized dexterity that is different from that for open surgery due to the translation of a three-dimensional working area into a two-dimensional video image, decreased tactile feedback, and the need for good eye-hand coordination (Ahn et al. 2013). We think that experience of open surgery is the basic of laparoscopic approach, accurate anatomy under laparoscopy and dexterous operation is the guarantee of success. More training should be proceeded before performing laparoscopic surgery for patients with gastric cancer and the supervision of expert laparoscopic surgeons may play a very important role.

Acknowledgements

The authors thank Jianjun Bi and Liu Qian for collecting and arranging data of patients. Their supports were the key factor in completing this paper.

References

Ahn CW, Hur H, Han SU, et al (2013). Comparison of intracorporeal reconstruction after laparoscopic distal gastrectomy with extracorporeal reconstruction in the view of learning curve. *J Gastric Cancer*, **13**, 34-43.

Akiyoshi T, Kuroyanagi H, Oya M, et al (2009). Short-term outcomes of laparoscopic rectal surgery for primary rectal cancer in elderly patients: is it safe and beneficial? *J Gastrointest Surg*, **13**, 1614-8.

Atrkar-Roushan Z, Kazemnejad A, Mansour-Ghanaei F, et al (2013). Trend analysis of gastrointestinal cancer incidences in Guilan province: comparing rates over 15 years. *Asian Pac J Cancer Prev*, **14**, 7587-93.

Chen Hu J, Xin Jiang L, Cai L, et al (2012). Preliminary experience of fast-track surgery combined with laparoscopy-assisted radical distal gastrectomy for gastric cancer. *J Gastrointest Surg*, **16**, 1830-9.

Hallet J, Labidi S, Bouchard-Fortier A, et al (2013). Oncologic specimen from laparoscopic assisted gastrectomy for gastric adenocarcinoma is comparable to D1-open surgery: the experience of a Canadian centre. *Can J Surg*, **56**, 249-55.

Haverkamp L, Weijs TJ, vander Sluis PC, et al (2013). Laparoscopic total gastrectomy versus open total gastrectomy for cancer: a systematic review and meta-analysis. *Surg Endosc*, **27**, 1509-20.

Hur H, Xuan Y, Ahn CW, et al (2013). Trends and outcomes of minimally invasive surgery for gastric cancer: 750 consecutive cases in seven years at a single center. *Am J Surg*, **205**, 45-51.

Hwang SI, Kim HO, Yoo CH, et al (2009). Laparoscopic-assisted distal gastrectomy versus open distal gastrectomy for advanced gastric cancer. *Surg Endosc*, **23**, 1252-8.

Jeong O, Jung MR, Kim GY, et al (2013). Comparison of short-term surgical outcomes between laparoscopic and open total gastrectomy for gastric carcinoma: case-control study using propensity score matching method. *J Am Coll Surg*, **216**, 184-91.

Jiang L, Yang KH, Guan QL, et al (2013). Laparoscopy-assisted gastrectomy versus open gastrectomy for resectable gastric cancer: an update meta-analysis based on randomized controlled trials. *Surg Endosc*, **27**, 2466-80.

Kim JW, Kim WS, Cheong JH, et al (2012). Safety and efficacy of fast-track surgery in laparoscopic distal gastrectomy for gastric cancer: a randomized clinical trial. *World J Surg*, **36**, 2879-87.

Kitano S, Iso Y, Moriyama M, et al (1994). Laparoscopy-assisted Billroth I gastrectomy. *Surg Laparosc Endosc*, **4**, 146-8.

Lee J, Kim W (2013). Clinical experience of 528 laparoscopic gastrectomies on gastric cancer in a single institution. *Surgery*, **153**, 611-8.

Lee JH, Son SY, Lee CM, et al (2013). Morbidity and mortality after laparoscopic gastrectomy for advanced gastric cancer: results of a phase II clinical trial. *Surg Endosc*, **27**, 2877-85.

Liao GX, Xie GZ, Li R, et al (2013). Meta-analysis of outcomes compared between robotic and laparoscopic gastrectomy for gastric cancer. *Asian Pac J Cancer Prev*, **14**, 4871-5.

Lin JX, Huang CM, Zheng CH, et al (2013). Laparoscopy-assisted gastrectomy with D2 lymph node dissection for advanced gastric cancer without serosa invasion: a matched cohort study from South China. *World J Surg Oncol*, **11**, 4.

Nakamura K, Katai H, Mizusawa J, et al (2013). A phase III study of laparoscopy-assisted versus open distal gastrectomy with nodal dissection for clinical stage IA/IB gastric Cancer (JCOG0912). *Jpn J Clin Oncol*, **43**, 324-7.

Qiu J, Pankaj P, Jiang H, et al (2013). Laparoscopy versus open distal gastrectomy for advanced gastric cancer: a systematic review and meta-analysis. *Surg Laparosc Endosc Percutan Tech*, **23**, 1-7.

Sakuramoto S, Yamashita K, Kikuchi S, et al (2013). Laparoscopy versus open distal gastrectomy by expert surgeons for early gastric cancer in Japanese patients: short-term clinical outcomes of a randomized clinical trial. *Surg Endosc*, **27**, 1695-705.

Shim JH, Park CH, Song KY (2013). Long-term comparison of laparoscopy-assisted distal gastrectomy and open distal gastrectomy in advanced gastric cancer. *Surg Endosc*, **27**, 2650-1.

Shinohara T, Satoh S, Kanaya S, et al (2013). Laparoscopic versus open D2 gastrectomy for advanced gastric cancer: a retrospective cohort study. *Surg Endosc*, **27**, 286-94.

Unal D, Oguz A, Acmaz B, et al (2014). Lack of any association between season of diagnosis and survival of gastric cancer cases in Kayseri, Turkey. *Asian Pac J Cancer Prev*, **15**, 1763-6.

Wan P, Yan C, Li C, et al (2012). Choices of surgical approaches for gastrointestinal stromal tumors of the stomach: laparoscopic versus open resection. *Dig Surg*, **29**, 243-50.

Zhao XF, Jeong O, Jung MR, et al (2013). A propensity score-matched case-control comparative study of laparoscopic and open extended (D2) lymph node dissection for distal gastric carcinoma. *Surg Endosc*, **27**, 2792-800.