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BRIEF ARTICLE

D2 dissection in laparoscopic and open gastrectomy for gastric cancer

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Abstract

AIM: To evaluate the radicalness and safety of laparoscopic D2 dissection for gastric cancer.

METHODS: Clinicopathological data from 209 patients with gastric cancer, who underwent radical gastrectomy with D2 dissection between January 2007 and February 2011, were analyzed retrospectively. Among these patients, 131 patients underwent laparoscopy-assisted gastrectomy (LAG) and 78 underwent open gastrectomy (OG). The parameters analyzed included operative time, blood loss, blood transfusion, morbidity, mortality, the number of harvested lymph nodes (HLNs), and pathological stage.

RESULTS: There were no significant differences in sex, age, types of radical resection [radical proximal gastrectomy (PG + D2), radical distal gastrectomy (DG + D2) and radical total gastrectomy (TG + D2)], and stages between the LAG and OG groups ($P > 0.05$). Among the two groups, 127 cases (96.9%) and 76 cases (97.4%) had 15 or more HLNs, respectively. The average number of HLNs was 26.1 ± 11.4 in the LAG group and 24.2 ± 9.3 in the OG group ($P = 0.233$). In the same type of radical resection, there were no significant differences in the number of HLNs between the two groups (PG + D2: 21.7 ± 7.5 *vs* 22.4 ± 9.3; DG + D2: 25.7 ± 11.0 *vs* 22.3 ± 7.9; TG + D2: 30.9 ± 13.4 *vs* 29.3 ± 10.4; $P > 0.05$ for all comparisons). Tumor free margins were obtained in all cases. Compared with OG group, the LAG group had significantly less blood loss, but a longer operation time ($P < 0.001$). The morbidity of the LAG group was 9.9%, which was not significantly different from the OG group (7.7%) ($P = 0.587$). The mortality was zero in both groups.

CONCLUSION: Laparoscopic D2 dissection is equivalent to OG in the number of HLNs, regardless of tumor location. Thus, this procedure can achieve the same radicalness as OG.

Key words: Gastric cancer; Laparoscopy; Gastrectomy; D2 dissection; Lymph node

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INTRODUCTION

Gastric cancer is the fourth most common cancer and the second leading cause of cancer-related deaths worldwide[1,2]. In the Far East countries such as China[3], Korea[4] and Japan[5], gastric cancer is the most prevalent malignancy, and the leading cause of cancer-related deaths. Since the first report of laparoscopic gastrectomy in 1992[6], laparoscopy-assisted gastrectomy (LAG) has been carried out not only in distal gastrectomy, but also in proximal gastrectomy and total gastrectomy[7-9]. Several randomized control trials (RCTs) have shown that LAG can be performed in early gastric cancer (EGC)[10-15]. However, LAG for the treatment of advanced gastric cancer (AGC) has remained controversial, mainly due to a lack of evidence from large-scale studies demonstrating that laparoscopic D2 dissection, the standard lymphadenectomy for AGC, is equivalent to open surgery. Recently, some studies have evaluated the outcome of D2 lymph node dissection in LAG and open surgery for gastric cancer[16-19]. The range of lymph node involvement differs due to the tumor location, thereby making the appropriate extent of D2 dissection vary as well[20]. However, little effort has been made to distinguish between tumors in different locations, all being simply regarded as "gastric cancer", or just evaluated as one type of LAG. In this study, we evaluated the overall radicalness of the laparoscopic D2 dissection of gastric cancer, and compared the differences between distal gastrectomy, proximal gastrectomy, and total gastrectomy.

MATERIALS AND METHODS

Patients

This retrospective study involved 221 consecutive patients with gastric cancer treated in the Department of Minimally Invasive Gastrointestinal Surgery, Peking University Cancer Hospital, between January 2007 and February 2011. The exclusion criteria included: (1) invasion of adjacent structures; (2) conglomeration of lymph nodes and no R0 resection; (3) distant metastases; and (4) absence of consent signing before operation. Blood tests, chest X-rays, enhanced computed tomography scans of the abdomen and pelvis, double-contrast upper gastrointestinal X-ray studies, and gastric endoscopy were performed before operation. All tumors were diagnosed as adenocarcinomas by biopsy. Informed consent was signed prior to surgery from each case. Among the 221 patients, 12 were excluded: 7 could not undergo R0 resection (3 with tumor invasion of adjacent structures, 4 with conglomeration of lymph nodes), 4 had distant metastases, and 1 refused operation. The study population thus included 209 cases that successfully underwent radical gastrectomy with D2 dissection. One hundred and thirty-one cases received LAG (LAG group) and 78 cases received open gastrectomy (OG group). All operations were performed by the same surgical team.

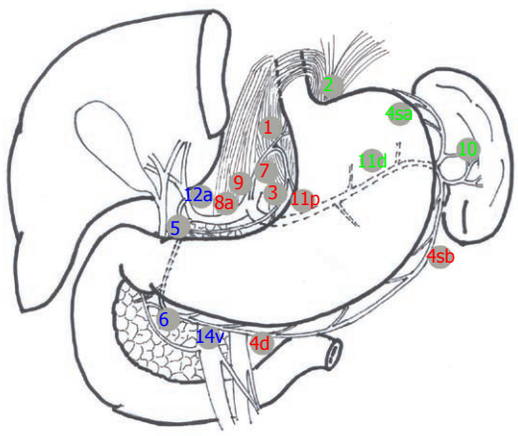

Figure 1 Lymph node stations of the stomach. The groups of lymph node in red, green and blue should be dissected in radical total gastrectomy; the groups of lymph node in red and green should be dissected in radical proximal gastrectomy; the groups of lymph node in red and blue should be dissected in radical distal gastrectomy.

Anesthesia and trocar placement

General anesthesia was administered with epidural analgesia to all the patients. The patients were placed in the supine position with legs apart. A 12-mm trocar for laparoscopy was introduced using the open technique below the umbilicus, and pneumoperitoneum at 10-13 mmHg was induced with carbon dioxide. Another 12-mm trocar was inserted at the left preaxillary line, 2 cm below the costal margin, to serve as a major hand port. Then a 5-mm trocar was placed at the left midclavicular line parallel to the umbilicus, and another 5-mm trocar was inserted at the contralateral site as an accessory port. The last 5-mm trocar was then placed at the right preaxillary line, 2 cm below the costal margin, also serving as another accessory port. The operator stood on the left side of the patient. The first assistant stood on the patient's right. The camera assistant stood between the patient's legs.

Surgical procedures

According to the guidelines of the Japanese Gastric Cancer Association (JGCA), the stomach was divided anatomically into three portions: upper, middle, and lower. The three portions were defined by subdividing both the lesser and greater curvatures into three equal lengths[20]. The type of gastrectomy and extent of D2 dissection were determined by tumor location (Figure 1)[20]. The aim of any oncological resection was to achieve en-bloc resection of gastric segment and surrounding lymph nodes, in order to obtain adequate oncological clearance.

Laparoscopy-assisted radical total gastrectomy with D2 dissection: This procedure was performed for gastric cancer involving more than 2/3 of the stomach. The greater omentum was first dissected, using the ultrasonicactivated scissors (Ultracision-Harmonic Scalpel; Ethicon Endo-Surgery Inc, Cincinnati, OH, United States), along the border of the transverse colon. The

left gastroepiploic vessel was vascularized, clamped with double Hem-o-lok clips (Teleflex Medical RTP, NC, United States) and cut at its origin. The gastrosplenic ligament was then divided and resected along the edge of spleen. These processes allowed the removal of No. 4sb, 4sa, and 10 lymph nodes. Then removal of No. 2 lymph nodes was performed. The next step was to resect the superior leaf of the mesocolon and the anterior leaf of the pancreas rightward the pylorus. The superior mesenteric vein, the Henle's trunk, the right colic vein, and the right gastroepiploic vessel were exposed allowing dissection of No. 14v lymph nodes. Then the right gastroepiploic vessel was clamped at its origin using double Hem-o-lok clips and cut, allowing No. 6 and 4d lymph nodes to be removed. In order to expose the gastropancreatic fold, the stomach was turned headward with the greater omentum folded up on the anterior aspect of the stomach. Along the gastroduodenal artery, the common hepatic artery could be skeletonized easily. The right gastric artery was divided and cut at its origin, using double Hem-o-lok clips, from the proper hepatic artery. Then dissection of No. 8a and 5 lymph nodes was completed. Once No. 8a lymph nodes were dissected, the procedure was continued leftward along the artery in order to remove the lymph nodes located along the celiac trunk (No. 9) and the left gastric artery (No. 7). The left gastric artery was cut from the celiac trunk using triple Hem-o-lok clips. Afterward, the celiac trunk was skeletonized. So, No. 7 and 9 lymph nodes were dissected. Then the splenic artery was skeletonized from its origin to the end in order to remove No. 11 lymph nodes. After returning the stomach and the greater omentum to normal position, the lesser omentum could be resected along the liver edge to the esophagogastric junction, with dissection of No. 1 and 3 lymph nodes. The last step of lymph node dissection was to skeletonize the proper hepatic artery, so No. 12a lymph nodes could be dissected. After standard D2 dissection was completed, an upper midline incision (about 5 cm) was made. The gastrectomy was performed and gastrointestinal continuity was restored in a Roux-en-Y fashion though this incision.

Laparoscopy-assisted radical proximal gastrectomy with D2 dissection: This procedure was performed for lesions located in the upper third of the stomach. The standard D2 dissection, including No. 1, 2, 3, 4, 7, 8a, 9, 10 and 11, was conducted using the same procedure described above. Esophagogastric anastomosis was performed to rebuild gastrointestinal continuity.

Laparoscopy-assisted radical distal gastrectomy with D2 dissection: This procedure was performed for lesions located in the lower third of stomach with or without involving the middle third of the stomach. The standard D2 dissection, including No. 1, 3, 4sb, 4d, 5, 6, 7, 8a, 9, 11p, 12a, and 14v, was conducted using the same procedure described above. Gastroduodenal anastomosis (Billroth Ⅰ) or gastrojejunal anastomosis (Billroth Ⅱ) was performed to rebuild gastrointestinal continuity.

Conventional open operation: The premedication and anesthetic techniques used were similar to the LAG group. Patients lay in the supine position, and the operator stood on the right side of the patient. An upper midline incision (about 20 cm) was made, and a standard gastrectomy with D2 dissection and reconstruction were performed in the same manner as in LAG.

Postoperative management

Nasogastric tube and nasojejunal tube were inserted routinely in operation. Enteral nutrition started through nasojejunal tube on the first postoperative day (POD). Gastroenterography, with the use of compound meglumine diatrizoate, was performed routinely to observe anastomosis on the 7th POD. If there was no evidence of anastomotic leakage by gastroenterography, the nasogastric tube could be removed and liquid diet was taken on the 8th POD.

Outcome evaluation

During surgery, operative time, blood loss (estimated by the volume of suction and the weight of gauze), and the amount of blood transfusion were recorded. Postoperative complications, categorized as surgical and nonsurgical complications, occurred during the hospital stay, and included fluid or abscesses needing drainage, intra-abdominal or anastomotic bleeding needing transfusion or reoperation, ileus, delayed gastric emptying, lymphatic leakage, and anastomotic leakage. Nonsurgical complications included cardiac, pulmonary, urinary, renal and hepatic complications. Mortality was defined as any death that occurred during hospital stay. The depth of tumor invasion, tumor size, margins, the number of harvested lymph nodes (HLNs), and positive lymph nodes were determined by pathological analysis. Histological staging was classified according to the 7th edition of the American Joint Committee on Cancer Staging Manual.

Statistical analysis

The data of patient's age, operation time, blood loss, and the number of lymph nodes were presented as $\chi \pm s$. Differences were compared in sex, type of resection, stage, and complications between the two groups using Chi-square test. Independent-sample *t* test was used to estimate differences in age, operation time, blood loss, and the number of HLNs between the two groups. *P* values less than 0.05 were considered statistically significant. All statistical analyses were performed with SPSS software, version 11.0 (SPSS Inc, Chicago, United States).

RESULTS

Patient clinicopathologic characteristics

Demographic details of the two groups are shown in Table 1. There were 88 males and 43 females in the LAG group, and the mean age of patients was 59.5 (range,

Table 1 Demographic characteristics of the two groups

Variable	LAG (n = 131)	OG (n = 78)	P value
Sex (male:female)	88:43	52:26	0.940
Age (yr)	59.5 ± 12.9	60.6 ± 10.3	0.523
Operation time (min)	259.1 ± 58.6	213.9 ± 37.6	0.000
Blood loss (mL)	111.1 ± 83.7	230.1 ± 96.8	0.000
Types of resections			
PG + D2	33	17	0.856
DG + D2	64	40	
TG + D2	34	21	
Stages			
Ⅰ (Ⅰa:Ⅰb)	29 (9:20)	12 (6:6)	0.253
Ⅱ (Ⅱa:Ⅱb)	28 (14:14)	13 (2:11)	
Ⅲ (Ⅲa:Ⅲb:Ⅲc)	74 (33:21:20)	53 (10:19:24)	

P values were calculated by independent-sample t test or by χ^2 test as appropriate. LAG: Laparoscopy-assisted gastrectomy; OG: Open gastrectomy; PG + D2: Radical proximal gastrectomy with D2 dissection; DG + D2: Radical distal gastrectomy with D2 dissection; TG + D2: Radical total gastrectomy with D2 dissection.

Table 2 Number of harvested lymph nodes in different types of radical resections

Groups	Number	Mean ± SD	P value
LAG	131	26.1 ± 11.4	0.233
OG	78	24.2 ± 9.3	
PG + D2	50	21.9 ± 8.1	0.000
DG + D2	104	24.4 ± 10.0	
TG + D2	55	30.3 ± 12.3	

P values were calculated by independent-sample t test. HLNs: Harvested lymph nodes; LAG: Laparoscopy-assisted gastrectomy; OG: Open gastrectomy; PG + D2: Radical proximal gastrectomy with D2 dissection; DG + D2: Radical distal gastrectomy with D2 dissection; TG + D2: Radical total gastrectomy with D2 dissection.

26-80) years. The OG group included 52 males and 26 females, with a mean age of 60.6 (range, 33-79) years. There were no significant differences in sex and age between the two groups (P = 0.940 and 0.523, respectively). Compared with the OG group, the LAG group had a significantly less blood loss (111.1 ± 83.7 mL in LAG *vs* 230.1 ± 96.8 mL in OG, P < 0.001), and a longer operation time (259.1 ± 58.6 min in LAG *vs* 213.9 ± 37.6 min in OG, P < 0.001). No blood transfusion was administered during surgery in either group.

Radical proximal gastrectomy with D2 dissection (PG + D2) was performed in 50 cases (33 in LAG and 17 in OG), radical distal gastrectomy with D2 dissection (DG + D2) in 104 cases (64 in LAG and 40 in OG), and radical total gastrectomy with D2 dissection (TG + D2) in 55 cases (34 in LAG and 21 in OG). There were no significant differences in the type of radical resection between the two groups (P = 0.856). Tumor free margins were obtained in all the patients. In the LAG group, there were 29 cases in stage Ⅰ, 28 cases in stage Ⅱ, and 74 cases in stage Ⅲ. In the OG group, there were 12 cases in stage Ⅰ, 13 cases in stage Ⅱ, and 53 cases in stage Ⅲ. There were no significant differences in pathological stages between the two groups (P = 0.253).

Table 3 Comparison of number of harvested lymph nodes between laparoscopy-assisted gastrectomy and open gastrectomy

Types of resections	Number	Mean ± SD	P value
PG + D2			
LAG	33	21.7 ± 7.5	0.770
OG	17	22.4 ± 9.3	
DG + D2			
LAG	64	25.7 ± 11.0	0.091
OG	40	22.3 ± 7.9	
TG + D2			
LAG	34	30.9 ± 13.4	0.653
OG	21	29.3 ± 10.4	

P values were calculated by independent-sample t test. HLNs: Harvested lymph nodes; LAG: Laparoscopy-assisted gastrectomy; OG: Open gastrectomy; PG + D2: Radical proximal gastrectomy with D2 dissection; DG + D2: Radical distal gastrectomy with D2 dissection; TG + D2: Radical total gastrectomy with D2 dissection.

Table 4 Postoperative complications in the two groups

Complications	LAG (n = 131)	OG (n = 78)	P value
Delayed gastric emptying	5	3	
Lymphatic leakage	3	2	
Anastomotic leakage	2	1	
Large pleural effusions	1		
Anastomotic bleeding	1		
Acute myocardial infarction	1		
Total (%)	13 (9.9)	6 (7.7)	0.587

P value was calculated by χ^2 test. LAG: Laparoscopy-assisted gastrectomy; OG: Open gastrectomy.

Number of harvested lymph nodes in different types of gastrectomies

Details of the number of HLNs are shown in Tables 2 and 3. In the LAG and OG groups, 127 (96.9%) cases and 76 cases (97.4%) had 15 or more HLNs. The average number of HLNs was 26.1 ± 11.4 in the LAG group and 24.2 ± 9.3 in the OG group (P = 0.233). The number of HLNs was 21.9 ± 8.1 in PG + D2, 24.4 ± 10.0 in DG + D2, and 30.3 ± 12.3 in TG + D2 (P < 0.001) (Table 2). In the same type of resection, there was no significant difference in the number of HLNs between the LAG and OG groups (PG + D2: 21.7 ± 7.5 in LAG *vs* 22.4 ± 9.3 in OG, DG + D2: 25.7 ± 11.0 in LAG *vs* 22.3 ± 7.9 in OG, TG + D2: 30.9 ± 13.4 in LAG *vs* 29.3 ± 10.4 in OG). P value was 0.770, 0.091 and 0.653, respectively (Table 3).

Morbidity and mortality after operation

Postoperative complications are listed in Table 4. Delayed gastric emptying (n = 5), lymphatic leakage (n = 3), anastomotic leakage without reoperation (n = 2), large pleural effusion needed drainage (n = 1), anastomotic bleeding needed transfusion (n = 1), and acute myocardial infarction (n = 1) occurred in the LAG group. Postoperative complications in the OG group included delayed gastric emptying (n = 3), lymphatic leakage (n = 2), and anastomotic leakage without reoperation (n = 1). There

were no significant differences in the morbidity between the two groups (9.9% *vs* 7.7%, $P = 0.587$). Mortality was zero in both groups.

DISCUSSION

For the treatment of AGC, surgical procedures include gastrectomy and lymphadenectomy. However, the extent of lymph node dissection has remained controversial worldwide[21]. In Eastern Asian countries such as Japan, China, and Korea, D2 dissection has been the standard operation[21]. However, in Western countries, D2 dissection is thought to be accompanied by significant mortality and morbidity, with no survival advantage[22,23]. Hartgrink *et al*[23] reported the results of a Dutch gastric cancer group trial in 2004, which included 711 patients who underwent randomly assigned treatment with curative intent (380 in D1 and 331 in D2). Both the postoperative morbidity (25% *vs* 43%, $P < 0.001$) and mortality (4% *vs* 10%, $P = 0.004$) were significantly higher in patients who underwent D2 dissection, while there was no difference in the 11-year overall survival (30% *vs* 35%, $P = 0.53$) between the two groups. Those results were similar to that of the Medical Research Council Gastric Cancer Surgical Trial[22]. However, the conclusions drawn from those two famous RCTs were questioned by Eastern investigators. The main concern was that 80 centers participated in the Dutch gastric cancer group trial, so the mean number of patients who underwent D2 dissection in each center was less than 5. Thus, the discommenders considered it very difficult to perform safe and standard D2 dissections in each center. Unexpectedly, in the 15-year follow-up from the Dutch gastric cancer group trial, published in 2010[24], the gastric-cancer-related death rate of the D2 group was significantly lower than that of the D1 group (37% *vs* 48%, $P = 0.01$), local recurrence was 12% in the D2 group *vs* 22% in D1, and regional recurrence was 13% in D2 *vs* 19% in D1. Thus, the authors recommended D2 dissection as the standard surgical approach for resectable gastric cancer. Currently, more and more evidences have proved D2 dissection as a feasible and safe procedure with survival advantages as compared with the D1 dissection[25-27], and D2 dissection has been gradually accepted by Western investigators. In the 2010 National Comprehensive Cancer Network guidelines, the panel recommended that gastric cancer surgery should remove D2 lymph nodes with the goal of examining 15 or more lymph nodes.

Although D2 dissection is performed in AGC as a standard procedure, more and more investigators have emphasized the need for D2 dissection in EGC because of pre-operative understaging[28-30]. In our hospital, about 90% of gastric cancers were initially diagnosed as AGC, and since endoscopic ultrasonography is not routinely performed, it is difficult to diagnose EGC preoperatively. Therefore, standard D2 dissection is routinely performed in all patients with gastric cancer in our hospital.

Laparoscopic surgery is a minimally invasive operation and is proved to be an acceptable alternative to open surgery in patients with colorectal cancer[31-33]. However, in gastric cancer, laparoscopic surgery has not yet been validated, and thus, was only performed in a limited number of patients with EGC in six small-scale RCTs[10-13,15,34]; this was due to the difficulties in systematic lymph node dissection, especially in the standard D2 dissection.

The number of HLNs is regarded as an important short-term oncological outcome of laparoscopic D2 dissection. Several recent retrospective studies have shown that laparoscopic D2 dissection is both a safe and oncologically feasible procedure, with a similar number of HLNs compared with open dissection[16-19,28,35,36]. Du *et al*[16] evaluated 82 patients with AGC who underwent laparoscopy-assisted total gastrectomy with D2 dissection compared with 94 patients who received open surgery; a similar number of HLNs was obtained in both groups (34.2 ± 13.5 *vs* 36.4 ± 19.1, $P = 0.331$). Huang *et al*[17] analyzed 66 cases of laparoscopy-assisted distal gastrectomy (LADG) with D2 dissection for AGC and 69 cases of open distal gastrectomy (ODG); no significant differences were found in the number of HLNs between the two groups (25.8 ± 12.5 *vs* 27.5 ± 10.3, $P = 0.401$). The morbidity in LADG was lower than that in ODG (6.1% *vs* 15.9%). Lee *et al*[18] evaluated 64 patients who underwent LADG with D2 dissection. The compliance rate, defined as cases with no more than one missing lymph node station according to JGCA lymph node grouping, was similar to that of ODG (67% *vs* 66%). The mean number of HLNs was 50.1 (range, 20-100), and the surgical morbidity and mortality were acceptable (3.1%, 0%, respectively).

There was still debate that the number of HLNs in laparoscopic D2 dissection was less than in the open D2 dissection[37,38]. Jeong *et al*[37] reported a study of 398 patients who underwent radical gastrectomy with R0 resection (261 in LAG and 138 in OG). The number of HLNs was significantly smaller in LAG than in OG (25 ± 13 *vs* 30 ± 14, $P < 0.01$). Lee *et al*[38] reported similar results in the number of HLNs (31.3 ± 11.1 *vs* 40.4 ± 17.9, $P < 0.001$). Unfortunately, in these two studies, the distribution of stages and the extent of lymph node dissection were not balanced between the two groups. The percent of AGC and D2 dissection in OG was higher than in LAG. This variability might explain the different number of HLNs between the two groups.

In this study, all patients successfully underwent radical surgery with D2 dissection. And 127 cases (96.9%) in the LAG group and 76 cases (97.4%) in the OG group had 15 or more HLNs. The mean number of HLNs was comparable between the LAG and OG groups ($P = 0.233$). The extent of D2 dissection should be decided in accordance with tumor location, so the number of HLNs was significantly different in different types of radical gastrectomies ($P < 0.001$). In addition, we analyzed the number of HLNs in different subgroups (PG + D2, DG + D2 and TG + D2) between LAG and OG, and found no significant differences ($P = 0.770$, 0.091

and 0.653, respectively). To our knowledge, this is the first published report that systematically compares the number of HLNs in different types of radical gastrectomies between LAG and OG. Similar to other studies, there was less blood loss, longer operation time, and comparable morbidity in LAG compared with OG.

Our team had completed more than 30 cases of LAG until this study. All operations, including LAG and OG, were performed by the same surgical team, thus allowing consistency of treatment, and all D2 dissections were completed successfully. The stages and types of radical resections were matched between the two groups. These are favorable conditions for comparing the number of HLNs, regardless of tumor location, between LAG and OG in a nonrandomized study.

However, there were some limitations in this study. First, this is a retrospective analysis. Second, there might be a selection bias as a result of comparing these nonrandomized groups to a retrospective profile. Third, there is no survival data. Thus, long-term oncological outcomes of LAG need to be evaluated in future studies.

In conclusion, our data suggests that the number of harvested lymph nodes of laparoscopic D2 dissection is equivalent to open surgery, regardless of the tumor location. Laparoscopic D2 dissection is safe, with less blood loss than open surgery, and can achieve the same radicalness as open surgery for gastric cancer. Large-scale RCTs with a longer follow-up period should be carried out in future studies to prove that LAG with D2 dissection is a good alternative to OG in selected patients.

COMMENTS

Background

Gastric cancer is one of the leading fatal malignancies worldwide, particularly in China and other Far Eastern countries. Laparoscopic surgery is a minimally invasive operation, which can be performed in colorectal cancer, and has been proved by many randomized control trials (RCTs). However, few studies have evaluated the role of laparoscopy-assisted gastrectomy (LAG) in gastric cancer.

Research frontiers

Several RCTs have shown that LAG can be performed in early gastric cancer. However, LAG for the treatment of advanced gastric cancer (AGC) has remained controversial. This is mainly due to a lack of evidence from large-scale studies showing that laparoscopic D2 dissection, the standard lymphadenectomy for AGC, is equivalent in outcome to open surgery.

Innovations and breakthroughs

In recent years, some studies have analyzed D2 dissection in LAG and open surgery for gastric cancer. Although the range of lymph node involvement differs by tumor location, making the extent of D2 dissection differ as well, little effort has been made to distinguish between tumors in various locations, with all simply being regarded as "gastric cancer" or just evaluated as one type of LAG. Thus, this study evaluated the overall radicalness of laparoscopic D2 dissection in gastric cancer, and further compared the difference among distal gastrectomy, proximal gastrectomy, and total gastrectomy.

Applications

This paper confirms the equivalent radicalness of D2 dissection between LAG and open surgery, thus providing preliminary evidence of the feasibility of applying LAG in gastric cancer, even in AGC. Long-term outcomes of LAG should be further studied.

Terminology

D2 dissection is the standard lymphadenectomy for AGC. The regional lymph nodes of the stomach are classified into three groups according to the guidelines of the Japanese Gastric Cancer Association. D2 dissection includes dissection of all Group 1 and Group 2 nodes. The extent of D2 dissection is different due to different tumor locations.

Peer review

The paper can be accepted for publication. The authors compared the radicalness of gastrectomy by laparoscopic and open approaches.

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