Original Article

A Comparative Study between Open and Laparoscopic Gastrectomy with D2 Lymph Node Dissection in Gastric Cancer

Wisit Kasetsermwiriya MD[1], Nut Tongbuasirilai MD[1], Piya Teawprasert MD, Msc[1], Suphakarn Techapongsatorn MD, Msc[1], Amarit Tansawet MD[1], Satit Srimonthayamas MD[1]

[1] Department of Surgery, Faculty of Medicine Vajira Hospital, Navamindradhiraj University, Bangkok, Thailand

Objective: To compare the early postoperative results of gastrectomy with D2 lymph node dissection in terms of operative time, complications and the number of harvested lymph nodes between the open and laparoscopic approaches.

Materials and Methods: Data of 38 patients with gastric cancer who underwent surgery from 2010 to 2015 were reviewed. Twenty-two patients who underwent successful laparoscopic surgery [LG] were compared with 16 patients who underwent open surgery [OG] in terms of operative time, intra-operative blood loss, rates of complications, length of hospital stay and the number of harvested lymph nodes.

Results: The clinicopathological characteristics between the LG group and the OG group were similar. The LG group required longer operative time (280 min in OG vs. 390 min in LG, $p = 0.010$) but experienced less volume of blood loss (200 ml in LG vs. 500 ml in OG, $p = 0.002$). Volume of blood transfusion was also significantly less in the LG group ($p = 0.012$). The length of hospital stay, number of harvested lymph nodes, rates of postoperative death and complications were not different between the two groups.

Conclusion: Laparoscopic gastrectomy with D2 lymph node dissection was a safe procedure with morbidity and mortality rates comparable to open surgery.

Keywords: Gastric cancer, Laparoscopic D2 gastrectomy, Low incidence country, Safety

J Med Assoc Thai 2018; 101 (Suppl. 8): S17-S22
Website: http://www.jmatonline.com

Gastric cancer is the fifth most common form of cancer and the third most common cause of cancer death worldwide[1]. In Thailand, gastric cancer is the sixth most common cancer in males, and the ninth most common in females. The annual incidence in Thailand is 5 per 100,000 populations, which is much lower than the incidence in East Asian countries. Nevertheless, gastric cancer patients in Thailand usually present in the late stage, thereby resulting in poor prognosis[2]. According to the Japanese gastric cancer association guidelines ver 3 (2010), the standard treatment for gastric cancer is gastrectomy with D2 lymphadenectomy. This includes a resection of the stomach with adequate free margin (at least 3 to 5 cm away from the lesion) along with a dissection of the lymph nodes around the stomach (at least 15 nodes) to the second-tier lymph node, which consists of the lymph nodes along the greater and lesser omentum, left gastric artery, celiac axis, splenic artery and splenic hilum[1,3,4].

In 1994, laparoscopic gastrectomy was firstly introduced by Kitano et al as an alternative surgical modality for gastric cancer[5]. Since then, the procedure has become popular in eastern Asian countries, where the incidence of gastric cancer is high[6]. Several studies, including multicenter prospective or randomized studies, have reported that

Correspondence to:
Kasetsermwiriya W. Department of Surgery, Faculty of Medicine Vajira Hospital, Navamindradhiraj University, Bangkok 10300, Thailand.
Phone: +66-2-2443282
E-mail: wisit@edu.vajira.ac.th

How to cite this article: Kasetsermwiriya W, Tongbuasirilai N, Teawprasert P, Techapongsatorn S, Tansawet A, Srimonthayamas S. A Comparative Study between Open and Laparoscopic Gastrectomy with D2 Lymph Node Dissection in Gastric Cancer. J Med Assoc Thai 2018;101;Suppl.8: S17-S22.

the laparoscopic approach yields advantages over open surgery in terms of faster recovery, shorter postoperative fever and less blood loss[4,7,8-15], whereas complications and the number of harvested lymph nodes were not different between the two approaches[7]. A drawback of laparoscopic approach is that it requires longer operative time than that for open surgery.

A previous Thai population-based study reported an overall 17% complication rate with no mortality among gastric cancer patients who underwent open gastrectomy with D2 lymph node dissection[16]. However, data on laparoscopic approach in terms of the safety profile and feasibility are still limited because this surgical procedure is a relatively new procedure in Thailand. At our institute, we have been performing this procedure for gastric cancer treatment since 2010.

This study aimed to compare the early postoperative results of gastrectomy with D2 lymph node dissection in terms of safety and quality of resected specimens between the open and laparoscopic approaches.

Materials and Methods

Study sample

The upper gastrointestinal surgery group of the Department of Surgery, Vajira Hospital, Bangkok, Thailand, performed a retrospective review of a collected database for gastric cancer patients who underwent gastrectomy with D2 lymph node dissection according to the Japanese gastric cancer treatment guidelines 2010[4]. The operations were performed between January 2010 and December 2015. The surgical approach was selected based on tumor location. All operations were performed by the same surgical team.

Clinical data were collected from medical records. These data included patient age and gender, clinical presentation, physical examination, operative details, clinical diagnosis, and tumor recurrence were reviewed. Pathological data included tumor staging (T stage), number of harvested lymph nodes, and histology. The included patients were classified into two groups based on the surgical procedure performed: laparoscopic surgery [LG group] or open surgery [OG group].

Outcome assessment

Intraoperative and postoperative data were reviewed. The primary end point of this study was the incidence of postoperative complications. We defined the definition of a complication as an adverse event that occurred within 30 days of surgery. When complications occurred in association with surgical technique near the operation field, such as wound or intra-abdominal cavity, they were considered local complications. A complication was classified as systemic when the complication was not associated with the operation field. The severities of complications were classified according to CTCAE v 4.0 assessment[17]. The secondary end point was that the quality of resected specimens should reflect the postoperative oncological outcome. We used the number of retrieved lymph nodes for assessment.

Surgical technique for laparoscopic resection

The type of gastric resection was determined according to tumor location. Distal gastrectomy was indicated for lesions in the lower third of the stomach. Total gastrectomy was indicated for lesions located above the mid body of the stomach. A pneumoperitoneum was created by the open technique, and five trocars were used (Figure 1). A 10 mm laparoscope, an ultrasonic dissector and bipolar were used for dissection. All patients underwent total omentectomy according to the level of gastric resection. A D2 lymph node dissection according to Japanese gastric cancer treatment guidelines 2010 was performed in all patients. After finishing lymph node dissection and resection of the stomach, the laparoscopic trocar incision was extended for removal of specimen after the wound protector was inserted. The reconstruction after distal gastrectomy was Roux-en-Y or Billroth II anastomosis and the reconstruction for total gastrectomy was Roux-en-Y.

Statistical analysis

Continuous variables were summarized as

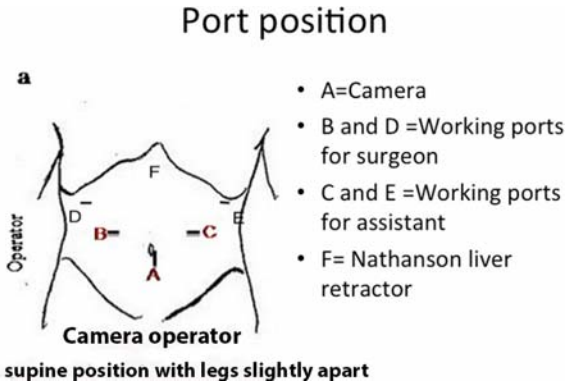

Figure 1. Laparoscopic port positioning (Figure by Kasetsermwiriya W).

mean (SD) or median (range) as appropriate. Categorized variables were summarized as percentages or counts. Statistical analysis of categorical variables was conducted with the chi-square test or Fisher's exact test. The Mann-Whitney U test was used to compare continuous parameters. A value of $p<0.05$ was considered statistically significant. All statistical analyses were performed using SPSS software (version 15.0 for Windows; SPSS, Chicago, IL, USA).

Results

There were 38 patients enrolled from January 2010 to December 2015; 16 patients (6 males and 10 females) underwent open gastrectomy and 22 patients (11 males and 11 females) underwent laparoscopic gastrectomy. Clinical and pathological characteristics of patients are summarized in Table 1. Median ages at diagnosis were 65.5 (range 41 to 81) years in the OG group and 66.0 (range 39 to 90) years in the LG group, respectively. Most tumors in both groups were poorly differentiated adenocarcinoma (10/16 in OG and 18/22 in LG). There were no significant differences between the LG and OG in terms of age, BMI, serum albumin level and underlying diseases. Distal gastrectomy was the most common type of gastrectomy in both groups (56.3% in OG and 77.3% in LG, $p = 0.165$). A half of patients in both groups were stage III (56.3% in OG and 50.0% in LG).

The results of early postoperative period outcomes are shown in Table 2. There were three

Table 1. Clinicopathological data of patients in both groups

Variables	OG (n = 16)	LG (n = 22)	*p*-value
Age (years), range	65.5 (41 to 81)	66.0 (39 to 90)	0.605
Sex, n (%)			0.440
Male	6 (37.5)	11 (50.0)	
Female	10 (62.5)	11 (50.0)	
Body mass index (kg/m^2), range	20.1 (14.7 to 27.6)	21.3 (17.3 to 36.5)	0.249
Serum albumin (mg/dl), range	3.7 (2.0 to 4.5)	3.8 (1.8 to 4.9)	0.756
Underlying diseases, n (%)			
Diabetes mellitus	5 (31.3)	6 (27.3)	0.790
Hypertension	4 (25.0)	10 (45.5)	0.197
Chronic kidney disease	0 (0)	1 (4.5)	0.387
COPD	2 (12.5)	0 (0)	0.088
Coronary artery disease	1 (6.3)	2 (9.1)	0.748
Cirrhosis	1 (6.3)	1 (4.5)	0.816
Type of gastrectomy, n (%)			0.165
Distal gastrectomy	9 (56.3)	17 (77.3)	
Total gastrectomy	5 (31.3)	5 (22.7)	
Combined resection	2 (12.5)	0 (0)	
Differentiated cell type, n (%)			0.181
Well differentiated	2 (12.5)	0 (0)	
Moderately differentiated	4 (25.0)	4 (18.2)	
Poorly differentiated	10 (62.5)	18 (81.8)	
Staging, n (%)			0.534
Tis	1 (6.3)	0 (0)	
Ia	1 (6.3)	1 (4.5)	
Ib	0 (0)	5 (22.7)	
IIa	0 (0)	0 (0)	
IIb	4 (25.0)	4 (18.2)	
IIIa	4 (25.0)	3 (13.6)	
IIIb	2 (12.5)	3 (13.6)	
IIIc	3 (18.8)	5 (22.7)	
IV	1 (6.3)	1 (4.5)	

COPD = chronic obstructive pulmonary disease; OG = open surgery; LG = laparoscopic surgery

complications in OG (18.8%) and five complications in LG (22.7%) but no difference between the two groups in terms of minor and major complications (p = 0.088 and p = 0.169, respectively). The details of major complications are shown in Table 3. There was one case of mortality in the LG group due to aspiration pneumonia during the induction of general anesthesia, with the patient subsequently developing severe acute respiratory distress syndrome immediately during the postoperative period. One patient in the laparoscopic group developed anastomosis leakage on the 5th day of the postoperative period. The patient underwent total gastrectomy with Roux- en-Y esophagojejunos tomy. The leakage was at the esophago-jejunal anastomosis caused by the malfunction of staples during anastomosis creation. This patient was treated conservatively, and the leakage closed after two weeks of treatment. The operative time of open gastrectomy was significantly less than the operative time of laparoscopic gastrectomy group (280 min vs. 390 min, p = 0.010). However, the volume of blood loss was less in the laparoscopic group (500 ml vs. 200 ml, p = 0.020). There were no significant differences in blood transfusions, time to oral feeding, and the length of hospital stay between the two groups. The number of harvested lymph nodes (28 nodes in OG and 33 nodes in LG, p = 0.260) and positive lymph nodes (2 nodes in OG and LG, p = 0.840) between the two groups was similar.

Discussion

We here in reported our initial experience with laparoscopic D2 radical gastrectomy for gastric cancer in the aspect of safety and the quality of surgery. Laparoscopic gastrectomy as a gastric cancer treatment has gained popularity since Kitano et al firstly reported

Table 2. Postoperative outcomes of patients in both groups

Immediate postoperative outcome	OG (n = 16)	LG (n = 22)	*p*-value
Minor complication, n (%)	3 (18.8)	3 (13.6)	0.682
Major complication, n (%)	0 (0)	2 (9.1)	0.499
Detail of complications, n (%)			
Surgical site infection	2 (12.5)	0 (0)	0.088
Pneumonia	1 (6.3)	3 (13.6)	0.464
Hemothorax	0 (0)	1 (4.5)	0.387
Bile leak	0 (0)	1 (4.5)	0.387
Anastomotic leak	0 (0)	1 (4.5)	0.387
Operative time (min), range	280 (125 to 515)	390 (285 to 590)	0.010
Blood loss (ml), range	500 (200 to 1,550)	200 (100 to 2,200)	0.020
PRC transfusion (unit), range	1 (0 to 2)	0 (0 to 4)	0.120
Time to oral feeding (day), range	4 (2 to 11)	4 (2 to 27)	0.179
Length of hospital stay (day), range	21.5 (12 to 70)	19 (7 to 43)	0.083
Harvested lymph node (node), rnge	28 (7 to 75)	33 (12 to 58)	0.261
Positive lymph node (node), range	2 (0 to 28)	2 (0 to 23)	0.845

Table 3. Patients with serious complications and outcomes

Age	Gender	Operation	Staging	Cell type	Complications	Outcome
70	Male	Laparoscopic distal gastrectomy	T3N2M0 (IIIA)	Poorly differentiated adenocarcinoma	Aspiration pneumonia	Developed severe ARDS and died 6 days after the operation
46	Female	Laparoscopic total gastrectomy	T3N1M0 (IIB)	Poorly differentiated adenocarcinoma	Anastomotic leakage	The leakage closed spontaneously after 2 weeks of conservative treatment

it in 1994[5]. However, Laparoscopic gastrectomy for gastric cancer treatment is quite new in Thailand and development of laparoscopic surgery for malignant gastric disease in Thailand has been slow to develop. This is because of the relatively low incidence of gastric cancer compared with that in East Asia, resulting in fewer opportunities for performing laparoscopic gastrectomy, which has a significant learning curve. We evaluated the morbidity and mortality of the patients enrolled in this study. To our knowledge, this study was the first comparative study of laparoscopic gastrectomy for gastric cancer conducted in Thailand. The second issue is that the feasibility of laparoscopic gastrectomy for advanced gastric cancer treatment is still controversial. Laparoscopic gastrectomy for the treatment of early gastric cancer has shown advantages over open surgery, as observed in many large trial studies[7,8,10,11]. However, the benefit of laparoscopic gastrectomy for advanced gastric cancer treatment has not been proved[18]. In our experience, laparoscopic gastrectomy for cancer is comparable to the open approach with respect to safety and oncologic principles of resection. The result of our study showed that laparoscopic gastrectomy took longer operative time than the open approach, but it had less intraoperative blood loss and there were no differences in complications. The explanation may be that the difficulty of laparoscopic technique during total omentectomy resulted in longer time than the open method. The second reason is the late pathological stage of our patients, because more than 50% of our patients who underwent laparoscopic surgery were stage III or IV, which increases difficulty for laparoscopic technique. Furthermore, the technical feasibility and favorable clinical outcomes of LG, and the quality of lymphadenectomy are also important factors in performing LG with D2 dissection. In our study, the number of retrieved lymph nodes reflects the oncologic aspect of resection between the LG and OG groups. The current study proved that LG with D2 lymph node dissection is technically feasible, with no significant difference in the number of retrieved lymph nodes between the two groups (LG = 33 vs. OG = 28, p = 0.260). Due to the the advanced stage of most gastric cancers in Thai patients, the number of cases that could be treated by minimally invasive surgery is relatively small**.** The findings from our study confirmed that the benefits of laparoscopic surgery are similar to studies from several eastern Asian countries[5-16]. Therefore, the laparoscopic technique remains feasible for treatment of advanced stage gastric cancer and confirms that it is in no way inferior to open gastrectomy. Furthermore, in cases of advanced gastric cancer, minimally invasive techniques are useful for staging the disease and selecting the appropriate treatment for each patient.

The present study has limitations inherent to its retrospective nature and the small number of patients included in the study due to the low incidence of gastric cancer in Thailand. Further research involving multi-center randomized prospective studies is required to establish the safety of laparoscopic gastrectomy for the surgical treatment of gastric cancer.

Conclusion

Laparoscopic gastrectomy with D2 lymph node dissection was a safe procedure with morbidity and mortality rates comparable to that of open surgery.

What is already known on this topic?

Gastric cancer is the 5th most common type of cancers in the world and the highest incidence in East Asian countries**.** However, the incidence in Thailand is much lower than that in other Asian countries. Laparoscopic gastrectomy has been proven as an effective treatment for early gastric cancer, but there were limited evidences to support this type of surgery for advanced gastric cancer. Furthermore, Thai patients with gastric cancer usually present in the later stage and there were limited studies of laparoscopic surgery for gastric cancer treatment.

What this study adds?

It has not already been known regarding the feasibility and safety of laparoscopic gastrectomy for advanced gastric cancer. As far as we know, this is the first study of laparoscopic gastrectomy in Thai patients with gastric cancer. This study revealed that laparoscopic gastrectomy with D2 lymph node dissection was a safe procedure with comparable morbidity and mortality to that of open surgery in Thai patients while maintaining the quality of surgery. Although the laparoscopic group required longer operative time, the volume of blood loss and transfusion were significantly less**.** However, large multicenter randomized control trials with long-term results are necessary to support this technique of surgery.

Acknowledgements

We thank Mr. Jason Douglas Cullen, Miss Piyanun Chaisiripanich and Mr. Thawin

Techapongsatorn for English proofreading of the manuscript.

Potential conflicts of interest

The authors declare no conflict of interest.

References

1. NCCN Clinical Practice Guidelines in Oncology. Gastric Cancer, Version 3.2015. Washington, PA: National Comprehensive Cancer Network; 2015.
2. Vilaichone RK, Panarat W, Aekpongpaisit S, Mahachai V. Clinical characteristics and Helicobacter pylori status of gastric cancer in Thailand. Asian Pac J Cancer Prev 2014;15:9005-8.
3. Hoshi H. Standard D2 and modified nodal dissection for gastric adenocarcinoma. Surg Oncol Clin N Am 2012;21:57-70.
4. Japanese Gastric Cancer Association. Japanese gastric cancer treatment guidelines 2010 (ver. 3). Gastric Cancer 2011;14:113-23.
5. Kitano S, Iso Y, Moriyama M, Sugimachi K. Laparoscopy-assisted Billroth I gastrectomy. Surg Laparosc Endosc 1994;4:146-8.
6. Lee HJ, Shiraishi N, Kim HH, Hiki N, Uyama I, Choi SH, et al. Standard of practice on laparoscopic gastric cancer surgery in Korea and Japan: experts' survey. Asian J Endosc Surg 2012;5:5-11.
7. Noshiro H, Nagai E, Shimizu S, Uchiyama A, Tanaka M. Laparoscopically assisted distal gastrectomy with standard radical lymph node dissection for gastric cancer. Surg Endosc 2005;19:1592-6.
8. Kim W, Kim HH, Han SU, Kim MC, Hyung WJ, Ryu SW, et al. Decreased morbidity of laparoscopic distal gastrectomy compared with open distal gastrectomy for stage I gastric cancer: Short-term outcomes from a multicenter randomized controlled trial (KLASS-01). Ann Surg 2016;263:28-35.
9. Inaki N, Etoh T, Ohyama T, Uchiyama K, Katada N, Koeda K, et al. A multi-institutional, prospective, Phase II feasibility study of laparoscopy-assisted distal gastrectomy with D2 lymph node dissection for locally advanced gastric cancer (JLSSG0901). World J Surg 2015;39:2734-41.
10. Kim HH, Hyung WJ, Cho GS, Kim MC, Han SU, Kim W, et al. Morbidity and mortality of laparoscopic gastrectomy versus open gastrectomy for gastric cancer: an interim report—a phase III multicenter, prospective, randomized Trial (KLASS Trial). Ann Surg 2010;251:417-20.
11. Katai H, Sasako M, Fukuda H, Nakamura K, Hiki N, Saka M, et al. Safety and feasibility of laparoscopy-assisted distal gastrectomy with suprapancreatic nodal dissection for clinical stage I gastric cancer: a multicenter phase II trial (JCOG 0703). Gastric Cancer 2010;13:238-44.
12. Shinohara T, Satoh S, Kanaya S, Ishida Y, Taniguchi K, Isogaki J, et al. Laparoscopic versus open D2 gastrectomy for advanced gastric cancer: a retrospective cohort study. Surg Endosc 2013;27:286-94.
13. Orsenigo E, Di Palo S, Tamburini A, Staudacher C. Laparoscopy-assisted gastrectomy versus open gastrectomy for gastric cancer: a monoinstitutional Western center experience. Surg Endosc 2011;25:140-5.
14. Fukunaga T, Hiki N, Kubota T, Nunobe S, Tokunaga M, Nohara K, et al. Oncologic outcomes of laparoscopy-assisted distal gastrectomy for gastric cancer. Ann Surg Oncol 2013;20:2676-82.
15. Huang JL, Wei HB, Zheng ZH, Wei B, Chen TF, Huang Y, et al. Laparoscopy-assisted D2 radical distal gastrectomy for advanced gastric cancer. Dig Surg 2010;27:291-6.
16. Euanorasetr C, Lertsithichai P. Results of D2 gastrectomy for gastric adenocarcinoma: 10-year experience in Thai patients. J Med Assoc Thai 2007;90:291-300.
17. U.S. Department of Health and Human Services. National Institutes of Health, National Cancer Institute. Common Terminology Criteria for Adverse Events (CTCAE) v 4.0. Published: May 28, 2009 (v4.03: June 14, 2010). Bethesda, MD: U.S. Department of Health and Human Services; 2010.
18. Antonakis PT, Ashrafian H, Isla AM. Laparoscopic gastric surgery for cancer: where do we stand? World J Gastroenterol 2014;20:14280-91.