

Comparison of outcomes between totally laparoscopic total gastrectomy and laparoscopic-assisted total gastrectomy for gastric cancer: A retrospective cohort study

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ABSTRACT

Introduction: To compare the efficacy and safety between totally laparoscopic total gastrectomy (TLTG) and laparoscopic-assisted total gastrectomy (LATG) with D2 lymph node dissection.

Materials and Methods: This was a retrospective cohort study comparing patients who underwent TLTG (group 1) and LATG with D2 lymph node dissection (group 2) between 01/2012 to 03/2020.

Results: 59 patients in the TLTG group and 36 patients in the LATG group with D2 lymph node dissection were included in the analysis. All cases in both groups showed no microscopic tumor cells on the proximal and distal resection margins (R0). Postoperative complications were lower in the TLTG group than in the LATG group ($p < 0.05$). There was no death during or after the surgery. The number of harvested lymph nodes in the TLTG group was higher than in the LATG group ($p < 0.05$). The operation time, gastric tube removal time, first flatus time, drain removal time, diet time, and hospital stay time in the TLTG group were shorter than the LATG group ($p < 0.05$). The mean postoperative survival times of the patients in both groups were insignificantly different ($p > 0.05$).

Conclusion: TLTG and LATG with D2 lymph node dissection were safe and effective in the treatment of gastric cancer. However, the TLTG had more benefits over LATG, as patients had less pain, and shorter intensive care, recovery, operative, hospital stay time. The surgical site by TLTG was also smaller than LATG.

Keywords: Comparative analysis; gastric cancer; laparoscopic assisted total gastrectomy; totally laparoscopic total gastrectomy.

Introduction

Gastric cancer is common in many countries over the world. Currently, gastric surgery is still the most effective treatment.^[1] Aazagra et al.^[2] is the first person in the world

who proceeded the laparoscopic gastrectomy in 1993. Until now, this procedure is widely applied in the treatment of gastric cancer. Its efficacy on the radical cancer treatment was proven with many advantages such as the small



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scar, mild pain after surgery, little blood loss, a fast time for recovery, low frequency of incidents and complications after surgery, good quality of life and longer survival for the patients.^[3-5]

There are two laparoscopic gastrectomy procedures, namely totally laparoscopic total gastrectomy (TLTG) and laparoscopic-assisted total gastrectomy (LATG) with D2 lymph node dissection. Which procedure should be used depending on the experience of surgeons, facilities, technical equipment, and health care cost of medical centers.

For the general evaluation of these two procedures, we conducted this study to compare the efficacy and safety between TLTG and LATG with D2 lymph node dissection.

Materials and Methods

Study Design and Participants

We conducted a retrospective cohort that included eligible participants who delivered to Nghe An Friendship General Hospital between 01/2012 and 03/2020, were prescribed TLTG or LATG with D2 lymph node dissection for the gastric cancer treatment.

TLTG was a procedure that performs in the abdomen consisting of gastrectomy, lymph node dissection, and the recovery of digestive tract circulation. LATG had some steps done in the abdomen including the mobilization of the stomach, lymph node dissection, cut and close the duodenum. Meanwhile, other steps were conducted via a small incision in the linea alba in the epigastrium with a length of 4–5 cm, including the cut of the esophagus and the recovery of digestive tract circulation.

Patients' characteristics were collected, namely age, gender, American Society of Anesthesiologists (ASA) classification, injury location, types of cancer, illness stage, injury size, and surgical procedures. Outcomes of patients were recorded and analyzed to make the comparison.

Patients were asked to return to the hospital following the scheduled on 1-month, 3-month, 6-month, 12-month, 18-month, 24-month for the first 2 years. For the following years, patients were monitored annually. We recorded necessary data in any visit at Nghe An Friendship General Hospital. If patients were passed away, we would contact with their relatives via phone or email to collect the date of death and the cause of death.

The study was approved by the ethic review board of the Nghe An Friendship General Hospital. The study complied with Declaration of Helsinki.

Study Outcomes

Surgical outcomes were the rate of open gastrectomy conversion, the operation time, the number of harvested lymph nodes, and the incidents during the surgery, pain levels after the surgery. The primary outcomes included time to first flatus, time of gastric tube removal, time to diet after the surgery, time to drain removal, complications after the surgery, and hospital stay. The secondary outcomes were full-length survival after the surgery.

The pain level was evaluated by the Visual Analogue Scale (VAS) for Pain.

Statistical Analysis

The software SPSS 22.0 was used to make the analysis. The comparison of means between two groups was made by using Independent Samples T-Test, the correlation test was done by Chi-square. The log-rank test was also used.

Results

Between 01/2012 and 03/2020, there were 59 patients received TLTG and 36 patients were prescribed LATG with D2 lymph node dissection for the gastric cancer treatment. The mean ages of patients and the ratio of male/female in both groups were 58.6 ± 8.9 years (29–83 years) and 4.3/1, respectively. There were no significant differences in mean ages and male/female ratio between two groups ($p > 0.05$). The physical examination showed that patients in the TLTG group had better health conditions than patients in the LATG group, as ASA classifications of two groups were statistically different ($p < 0.05$). ASA score of 1 and 2 was major (95.8%). The tumor location and tumor size were not different between the two groups ($p > 0.05$). The distance from the tumor margin to the cardia was shorter for patients in the LATG group than in the TLTG group ($p < 0.05$). Fifty-nine patients (62.1%) in the TLTG group, 36 patients (37.9%) in the LATG group, and 100% of patients undergoing D2 lymph node dissection did not have the incidents leading to the open gastrectomy conversion. The differentiation of tumor cells was not different between the two groups ($p > 0.05$) (Table 1).

The tumor stage was also insignificantly different between the two groups (Table 2). In general, the percentages of tu-

Table 1. Characteristics of studied participants

	TLTG	LATG	p
Age (years)	59.6±9.2	57.1±8.2	>0.05
Male/female ratio	4.9/1	3.5/1	>0.05
ASA, n (%)			
1	52 (54.7)	19 (20.0)	<0.05
2	4 (4.2)	16 (16.8)	
3	3 (3.2)	1 (1.1)	
Tumor size (cm)	3.9±1.5	3.9±1.6	>0.05
Tumor locations, n (%)			
One-third upper	8 (8.4)	8 (8.4)	>0.05
Middle	46 (48.4)	26 (27.4)	
With ulceration	5 (5.3)	2 (2.1)	
The distance from injury to the cardia (cm)	3.1±0.8	2.5±0.9	<0.05
Type of gastric cancer, n (%)			
Adenocarcinoma	45 (47.4)	22 (23.2)	>0.05
Ring cell carcinoma	12 (12.6)	12 (12.6)	
Mucous carcinoma	2 (2.1)	2 (2.1)	
Differentiation, n (%)			
High	2 (2.1)	2 (2.1)	>0.05
Moderate	22 (23.2)	7 (7.4)	
Low or none	35 (36.8)	27 (28.4)	

Data was shown by mean±SD; LATG: laparoscopic assisted total gastrectomy; TLTG: totally laparoscopic total gastrectomy.

Table 2. TNM classifications of the participants

	TNM classifications												p		
	IA		IB		IIA		IIB		IIIA		IIIB			IIIC	
	n	%	n	%	n	%	n	%	n	%	n	%		n	%
TLTG	3	3.2	9	9.5	20	21.1	14	14.7	4	4.2	6	6.3	3	3.2	>0.05
LATG	2	2.1	3	3.2	13	13.7	13	13.7	2	2.1	2	2.1	1	1.1	

LATG: laparoscopic assisted total gastrectomy; TLTG: totally laparoscopic total gastrectomy.

mor stages IA, IB, IIA, IIB, IIIA, IIIB, IIIC were respectively 5.3%, 12.6%, 34.7%, 28.4%, 6.3%, 8.4%, 4.2%.

In our study, there were 47 patients of TLTG group and 31 patients of LATG group, who had tumor stages from IIA to IIIC, receiving the adjuvant chemotherapy of XELOX regimen (oxaliplatin 130 mg/m² via intravenous injection on day 1, capecitabine 1000–1250 mg/m² per oral twice a day from day 1 to day 14). These patients would be received 8 cycles of treatment with 3 weeks each cycle. No case underwent adjuvant radiotherapy before and

after the surgery. Amongst 95 patients who underwent total gastrectomy with D2 lymph node dissection in this study, there were 6.4% of cases having mild complications during the surgery. These cases were handled in the laparoscopic gastrectomy. Of 9.6% of cases having complications after the surgery, all cases were well treated with internal medicine. There were no death cases during and after the surgery. The rates of incidents of patients in the TLTG group and the LATG group were 3.2%, and there was not significantly different (p>0.05). The rate of complica-

Table 3. The incidents during the surgery and the complications after the surgery

Incidents and complications	TLTG	LATG	p
Incidents			
Splenic injury during the surgery	1	1	0.647
Hepatic injury during the surgery	1	2	
Serosal laceration of small intestine	1	0	
Other incidents	0	0	
Complications			
Pneumonia after the surgery	1	0	0.029
Residual abscess after the surgery	1	2	
Duodenal leakage after the surgery	0	0	
Anastomotic leakage after the surgery	0	1	
Wound infection	0	4	
Other complications	0	0	

LATG: laparoscopic assisted total gastrectomy, TLTG: totally laparoscopic total gastrectomy.

tions after the surgery in the TLTG group was significantly lower than in the LATG group, by 2.2% vs 7.6% ($p < 0.05$) (Table 3).

Regarding the pain after the surgery, patients in the TLTG group suffered significantly less pain than in the LATG group ($p < 0.05$) (Table 4). LATG procedure caused a small incision in the linea alba in the epigastrium of 4–5 cm as

Table 4. Pain levels after the surgery

	Pain levels						p
	Mild		Moderate		Severe		
	n	%	n	%	n	%	
TLTG	36	37.9	21	22.1	2	2.1	<0.05
LATG	9	9.5	21	22.1	6	6.3	

LATG: Laparoscopic assisted total gastrectomy; TLTG: Totally laparoscopic total gastrectomy.

the anastomosis, thus, led to the more severe pain in the LATG compared to the TLTG group.

Total harvested lymph nodes were 1962 with the average number of 20.7 ± 8.3 (10–45). Total metastatic lymph nodes were 241 with an average of 2.5 ± 3.5 (0–13). The proximal and distal resection edges showed the complete absences of tumor cells. The operation time, time of gastric tube removal after the surgery, time to first flatus, time to drain removal, time to diet, and hospital stay in the TLTG group were statistically shorter than the LATG group ($p < 0.05$) (Table 5). These results were reflected by reality. For instance, TLTG reduced more manipulations, skills, caused smaller incision, and avoided strong traction on the abdominal wall which helped to shorten the operation time and time to recover the digestive tract circulation compared to LATG. Thus, the time for health care and treatment of the TLTG group was shorter than the LATG group. The full-length survival was not different between the TLTG and the LATG groups ($p > 0.05$).

The 1-year survival and 5-years survival under the Kaplan-Meier method were 97.15% and 59.3%, respectively, for

Table 5. Postoperative outcomes

Outcomes	TLTG	LATG	p
The number of harvested lymph nodes	22.1±8.6	18.3±7.4	<0.05
Operation time (min)	204.2±26.6	220.1±40.9	<0.05
Time of gastric tube removal (hours)	38.7±29.6	72.8±23.9	<0.01
Time to first flatus (hours)	49.7±15.2	55.4±29.0	<0.05
Time to drain removal (days)	3.7±1.2	4.9±0.9	<0.01
Time to diet (days)	4.8±1.2	6.1±0.8	<0.01
Hospital stay (days)	8.4±2.3	10.1±2.5	<0.01
Survival after the surgery (months)	57.7±3.7	55.2±2.6	>0.05

Data shown by mean±SD; LATG: laparoscopic assisted total gastrectomy; TLTG: totally laparoscopic total gastrectomy.

the TLTG groups; while they were 97.0% and 46.6%, respectively, for the LATG group. In our study, the mean full-length survivals of these groups were 55.2 ± 2.3 months, ranging from 50.7 months to 59.8 months (Fig. 1).

Discussion

The mean ages of patients and the ratio of male/female in both groups were 58.6 ± 8.9 years (29–83 years) and 4.3/1, respectively. There were also no differences between mean ages and gender between the two groups ($p < 0.05$). Previous reports showed that the mean ages of gastric cancer were 62.7–64.8 years in Japan, 63.6–73 years in Europe and America, and 54.6–57.6 years.^[6–8] The physical examination showed that patients in the TLTG group had better health condition than patients in the LATG group, as ASA classifications of two groups were statistically different ($p < 0.05$). ASA score of 1 and 2 was major (95.8%). Patients in both groups of TLTG and LATG were prescribed total gastrectomy for the treatment of cardia cancer, corpus cancer, gastric cancer with ulceration, cases that the distance between tumor margin and cardia was below 6 cm with the aim of complete clearance of tumor cells. In these cases, we performed the cut of esophagus 2 cm-above the cardia, the cut of duodenum 1.5 cm-right below the pylorus. This distance in the report of Huscher et al.^[7] was 6.9 ± 0.8 cm (6–8 cm). According to Ryota (2016), the resection edge must be at least 5 cm from the tumor margin. For gastric tumor with ulceration, the distal edge was from pylorus to duodenum, the proximal resection edge was at least 6–8 cm from the tumor margin. For tumors located at the corpus and one-third of the upper stomach, it should be total gastrectomy. The distance from the injury

margin to the proximal edge plays an important role in the laparoscopic gastrectomy. To avoid the recurrence at the anastomosis, the newest recommendations of the Japanese Gastric Cancer Association and American Cancer Society agreed that the distance from the injury margin to the proximal edge should be minimal 5 cm. In our study, the tumor locations of two groups were 15.7% for one-third of the upper stomach, 75.7% for the middle, 8.6% of cases having ulceration. But there were no significant differences between the two groups ($p < 0.05$). The tumor sizes of the two groups were similar ($p > 0.05$), but the distance from the tumor margin to the cardia in the LATG group was shorter than in the TLTG ($p < 0.05$). This means when the tumor is close to the cardia or at the cardia, the suture by the circular stapler method would easier apply than the linear stapler method. All patients in our study had no tumor cells in the proximal and distal resection edges (R0).

For the total gastrectomy, all patients undergoing laparoscopic gastrectomy with D2 lymph node dissection (59 cases in the TLTG group and 36 cases in the LATG group) did not need the open gastrectomy caused by incidents. In the TLTG group, we performed the cut of the stomach, the of lymph nodes, and created the esophagojejunostomy functional end-to-end anastomosis and the jejunojunctionostomy end-to-side anastomosis by the linear stapler method (2–3 Echelon Stapler 60B) entirely in the abdomen.

LATG only had some steps done in the abdomen including the mobilization of the stomach, lymph node dissection, cut and close the duodenum. Meanwhile, we conducted other steps via a small incision in the linea alba in the epigastrium (mini-open). For example, the orvil for end-to-side anastomosis was conducted by a circular stapler method, while the jejunojunctionostomy end-to-side anastomosis was conducted by the linear stapler method (2–3 Echelon Stapler 60B).^[9–12] The difference between TLTG and LATG is the difference in cutting esophagus and making the esophagojejunostomy anastomosis leading to the different choice of manipulations and sutural methods. We realized that the cut of the esophagus, the esophagojejunostomy anastomosis, and the jejunojunctionostomy anastomosis was easier conducted by TLTG. Because of the wider surgical area, the procedure was conducted easily with fewer manipulations. These led to the reduction of the operation time, small incision, less pain for patients, and better appearance of the surgical site. No complication of digestive leakage or anastomotic stenosis

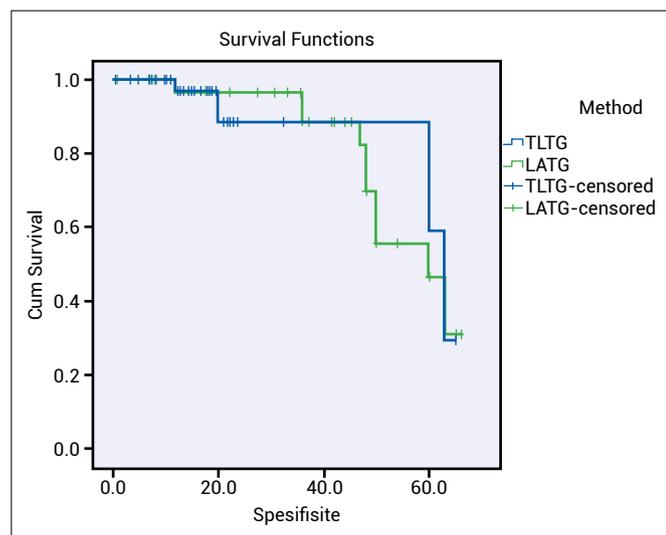


Figure 1. Full-length survival of patients in both groups.

was observed in the LATG group. However, for the cases of tumor close to the cardia or the cardia tumor, we should make a priority of using the circular stapler method for the orvil end-to-side anastomosis, as it made the procedure smoother.

Using the TNM categories mentioned by the Union Internationale Contre le cancer (UICC) (2009), the American Joint Committee on Cancer (AJCC) (2010) and Japanese Research Society for Gastric Cancer (JRS GC) (2011),^[13, 14] the tumor stages IA, IB, IIA, IIB, IIIA, IIIB, IIIC were 5.3%, 12.6%, 34.7%, 28.4%, 6.3%, 8.4%, 4.2%, respectively. The distribution of these classifications was not different between the two groups ($p > 0.05$).

For the dissection of lymph nodes in total gastrectomy, we followed the procedure mentioned by JRS GC (2011).^[13-15] Total harvested lymph nodes of two groups were 1962 with an average of 20.7 ± 8.3 (10–45). The number of harvested lymph nodes in the TLTG group was larger than in the LATG group ($p < 0.05$). This was possibly due to the smaller sample in the LATG group. Other reports showed the smaller harvested lymph nodes, by 18–30.3.^[7,16]

Regarding incidents during the surgery, there was one case (1.1%) in the TLTG group having liver injury when mobilizing the liver leading to the bleed of the hepatic parenchyma. One case (1.1%) had bleeding spleen during the mobilization of the reticulum. Another case (1.1%) had the serosal laceration of the small intestine when suturing the digestive tract. In the LATG group, there were two cases (2.1%) having a hepatic injury, and one case (1.1%) having a bleeding spleen. All these cases underwent the hemostasis by the electrocautery and the suture of serosa during the laparoscopy. No other incidents or death cases were recorded after the surgery. The incident rates between TLTG and LATG groups had no difference ($p > 0.05$). In previous reports, the incident rate ranged from 0.9–7.4%.^[3,4,17,18]

About the complications, there was one case (1.1%) having a residual abscess in the liver, one case (1.1%) had pneumonia after surgery in the TLTG group. In the LATG group, there were two cases (2.1%) having a residual abscess in the liver, one case having anastomotic leakage after surgery and four cases (4.2%) had wound infection. All cases were internal medicine treated. No death case after the surgery. The rate of complications in the TLTG group was much lower than in the LATG group (2.2% vs 7.6%, $p < 0.05$). These rates in other studies were 21–26%.^[7,16]

After the surgery, the patients received convenient treat-

ment for pain relief twice a day. Some cases were received epidural block to reduce pain. However, almost all patients had moderate and mild pain. For patients with severe, they were prescribed morphine, then no pain was reported. The pain levels in the TLTG group were significantly lower than in the LATG group ($p < 0.05$).

The mean operation time was 204.2 ± 26.6 minutes in the TLTG group, and 220.1 ± 40.9 minutes in the LATG group. These results were in line with previous studies.^[17,19] The time to first flatus in our study was shorter than in the report of Noshiro et al.^[20] (67.2 hours). The hospital stay in our study was concordant with other studies.^[21,22] The time of gastric tube removal was 38.7 ± 29.6 hours (for the TLTG group) and 72.8 ± 23.9 hours (for the LATG group). The time to drain removal was 3.72 ± 1.2 days and 4.9 ± 0.9 days for the TLTG group and the LATG group, respectively. The nasogastric tube insertion often made patients uncomfortable and reduced their quality of life. In our study, however, all patients (95 cases) did not experience the anastomotic hemorrhage due to the suture of the digestive tract via the Stapler technique. This meant no need for nasogastric tube intubation after the surgery. The operation time, time of gastric tube removal, time to first flatus, time to drain removal, time to diet, and hospital stay in the TLTG group were shorter than the LATG group ($p < 0.05$).

The 1-year and 5-years survival after the surgery by Kaplan-Meier method was 97.15% and 59.3% for the TLTG group, and 97.0% and 46.6% for the LATG group. The mean full-length survival of two groups in our study was 55.2 ± 2.3 months (50.7–59.8 months). However, no difference between the two groups was observed ($p > 0.05$). Chen et al.^[21] revealed that the 12 months-survival after the surgery was 91.5%. Some reports in Vietnam indicated that survival after surgery ranged from 40.2–43.8 months.

Conclusion

Our study investigated 59 patients undergoing TLTG and 36 patients undergoing LATG with D2 lymph node dissection. We realized the procedures were safe and effective in gastric cancer treatment. However, TLTG had more benefits than LATG, such as less pain for patients, lower frequency of complications after surgery, shorter time for intensive care and recovery, shorter operation time, and hospital stay. The surgical site by TLTH was also better than LATG. In the case of cardia cancer with the size over 3 cm, it should be handled with the orvil for end-to-side anastomosis by circular stapler method.

Disclosures

Ethics Committee Approval: The study was approved by the ethic review board of the Nghe An Friendship General Hospital. The study complied with Declaration of Helsinki.

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Conflict of Interest: None declared.

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