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The Safety and Efficacy of Total Laparoscopic Distal Gastrectomy With Delta-Shaped Anastomosis Compared With Laparoscopic-Assisted Distal Gastrectomy

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Aim: To evaluate the safety and short-time benefits of enhanced recovery after surgery on hospital stay, recovery of gastrointestinal function and complications after total laparoscopic distal gastrectomy (TLDG) with delta-shaped anastomosis, comparing with laparoscopic-assisted distal gastrectomy (LADG).

Methods: A retrospective analysis was performed in 134 patients with gastric cancer who were treated at Wuhan General Hospital of Guangzhou Military Area Command from November 2013 to August 2015. A total of 70 patients underwent TLDG, and 64 patients underwent LADG. All patients were performed elective standard D2 total gastrectomy by 1 group of experienced surgeons. The short-term therapeutic benefits, including duration of flatus and defecation, postoperative pain, duration of postoperative stay, and complications between the 2 groups were analyzed.

Results: Compared with LADG, TLDG had shorter time to the first flatus (74.09 ± 11.08 hours versus 84.11 ± 12.18 hours, $P < 0.001$), earlier postoperative liquid diet intake (98.83 ± 10.63 hours versus 108.58 ± 13.08 hours, $P < 0.001$), less dosage of pain killers (2.01 ± 0.85 versus 2.41 ± 0.85, $P = 0.009$), faster recovery with a shorter postoperative hospital stay (8.14 ± 0.3.43 days versus 9.97 ± 4.53 days, $P = 0.009$), There were no significant difference in operation time, blood loss, the number of lymph nodes retrieved, or the incidence of

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postoperative complications (anastomotic bleeding or leakage, wound infection, digestive tract dysfunction, thrombosis, or death; $P > 0.05$).

Conclusions: TLDG with delta-shaped anastomosis is a safe and effective fast-tract surgical approach for earlier gastric cancer, which would probably achieve the short-term curative effect. Further studies based on larger volumes and long-term effects are required to confirm these findings.

Key words: Total laparoscopic distal gastrectomy – Laparoscopy-assisted D2 radical gastrectomy – Delta-shaped anastomosis – Gastric cancer surgery

In China, over 400,000 patients are diagnosed gastric cancer annually, and most of gastric cancer patients (>90%) are diagnosed at an advanced stage when they first present.[1] At present, radical surgery with curative intent is the only effective treatment for gastric cancer, which provides a potential hope to cure.[2] In the last century open gastrectomy with lymph node (LN) dissection has become the foundation stone of gastric cancer therapy for nonmetastatic disease in medically fit patients.[3]

In 1992, Kitano performed the first laparoscopic-assisted gastrectomy for gastric cancer in Japan.[4] With the improvement of laparoscopic instruments and techniques, laparoscopic surgery for gastric cancer has gained popularity.[5] Several reports comparing open gastrectomy and laparoscopic-assisted surgery for early gastric cancer showed several advantages of the laparoscopic approach over conventional open surgery.[6,7]

The delta-shaped anastomosis in totally laparoscopic Billroth I gastrectomy was first reported by Kanaya *et al*.[8] Reports[8,9] also indicate that delta-shaped anastomosis is a feasible reconstruction method, which can be completed in a short time under total laparoscopy. Because of its feasibility and satisfactory results,[9] totally laparoscopic gastrectomy with delta-shaped anastomosis has been accepted and performed in our institution. The short-term outcomes of totally laparoscopic gastrectomy have recently been reported, but these studies need more samples. In this study, we compared the short-term outcomes between TLDG and LARG in patients with gastric cancer in our department, tried to figure out whether TLDG could contribute to perioperative care.

Materials and Methods

Patients

This study included 134 patients with primary distal gastric cancer (GC) who were treated with radical gastrectomy at Wuhan General Hospital of Guangzhou Military Area Command from November 2013 to August 2015. A total of 64 patients underwent laparoscopy-assisted D2 radical gastrectomy (LADG), whereas the other 70 patients underwent total laparoscopic distal gastrectomy (TLDG) with delta-shaped anastomosis. All patients were primary diagnosed as distal GC preoperatively by gastroscopic biopsy specimens, physical examination. The tumor site, depth of invasion, extent of lymph node (LN) metastasis, and distant metastasis disease were evaluated by endoscopy, transabdominal sonography and/or chest radiography, computed tomography (CT) scan or magnetic resonance imaging (MRI) examination preoperatively. Patients with distant metastasis or switch from laparoscopic surgery to an open approach were excluded. The clinic characteristics of patients were presentation in Table 1. Surgery was performed by the same surgical team in all cases. All the patients had been followed up for 6 months or more postoperatively. A retrospective analysis was performed to assess the safety and feasibility of the technique.

Surgical procedures

The operation was performed by the same team. The patient was placed in a leg-split position under general anesthesia. A 10-mm trocar for video port was inserted below the umbilicus, a 5-mm trocar was inserted into the right preaxillary line 2 cm below the costal margin and a 12-mm trocar in the right midclavicular line 2 cm above the umbilicus as a major hand port, another 5-mm and 12-mm trocars were placed at the contralateral site on the left (Fig. 1). The surgeon stood on the patient's right side and the assistant on the patient's right side, the camera assistant stood between the patient's legs. The intraperitoneal pressure was kept at 10 to 14 mmHg by carbon dioxide (CO_2) insufflation. The operator was standing on the right side of the patient, while

Table 1 The comparison of general characteristics[a]

	LADG (n = 64)	TLDG (n = 70)	*P* value	t(χ^2)
Age (year), mean ± SD	55.02 ± 7.33	54.48 ± 8.03	0.073	−1.805
Sex ratio(male to female)	36:28	39:31	0.95	0.004
BMI, mean ± SD	23.99 ± 2.48	24.40 ± 2.15	0.3	−1.041
Size of tumor (cm), mean ± SD	4.41 ± 1.16	4.04 ± 1.22	0.075	1.794
TNM stage (n) 0.764				0.09
I	30	31		
II	34	39		

BMI, body mass index; LADG: Laparoscopic assisted distal gastrectomy; TLDG: total laparoscopic distal gastrectomy.
[a]Values are presented as mean ± standard deviation or number (%).

the first assistant was standing on the left side. D2 radical gastrectomy and the LN dissections were performed based on the guidelines of the Japanese Classification of Gastric Carcinoma (JCGC).[10]

LADG

LADG procedure with D2 lymph node dissection was performed according to the report by Yian Du.[11] When the laparoscopic operation was completed, an auxiliary incision about 5 cm below the xiphoid was made to remove of the entire specimen. The residual stomach and duodenum were anastomosed.

Fig. 1 Port sites.

TLDG with delta-shaped anastomosis

Delta was performed according to the procedure reported by Kanaya *et al*.[8,9] The gastroduodenostomies were reconstructed using 60-mm endoscopic linear stapler. A functional end-to-end anastomosis of the remnant stomach and the duodenal stump was created by firing a 60-mm linear stapler three times intracorporeally (Fig.2). The umbilical port wound was extended to about a 3-cm vertical incision, through which the specimen placed in a retrieval bag was extracted.

Observation indexes

The following indexes were observed and compared to assess the therapeutic efficacy, including operation time, the number of lymph nodes dissected, intraoperative blood loss, duration of flatus and defecation, postoperative pain, time to normal diet, duration of postoperative stay, and complications.

Statistical analysis

All data were performed using SPSS18.0 for statistically. The data were presented as means ± standard deviation (SD). The methods of t-test, χ^2-test were used to compared values for continuous data and categorical data separately between the two groups. A value of $P < 0.05$ was considered statistically significant.

Results

Patient characteristics

A total of 70 patients, including 39 men and 31 women with a mean age of 54.48 years, were included in the TLDG group. In the LADG group, there were 36 men and 28 women with a mean age of 55.02 years. There were no significant differences

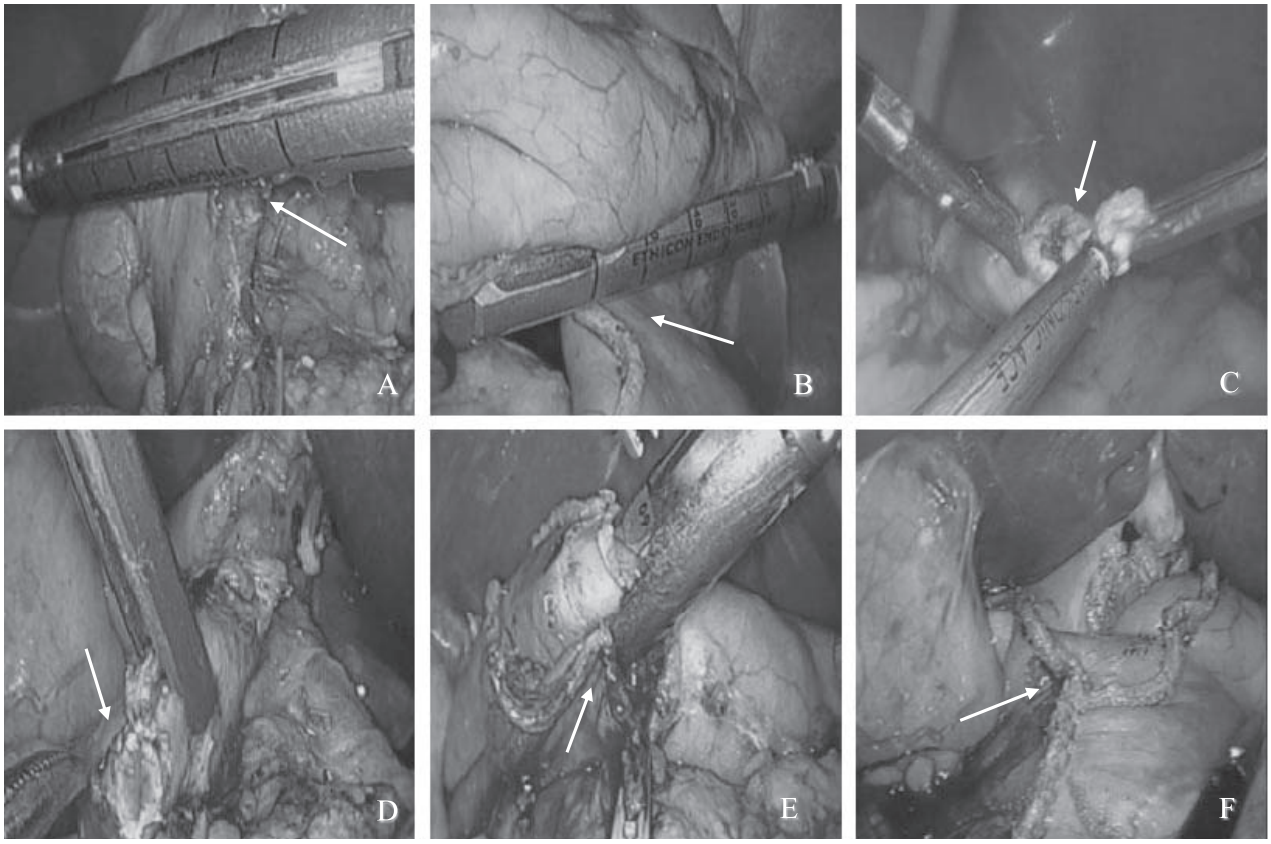

Fig. 2 The delta-shaped anastomosis: (A) the duodenum was divided; (B) distal gastrectomy was performed with two or three 60-mm linear staplers; (C) small incision on greater curvature side; (D) small incision in duodenum; (E) The posterior walls of both the remnant stomach and the duodenum are approximated with 60-mm linear staplers; (F) The entry hole was closed.

between the 2 groups in terms of age, sex, BMI, size of tumor, and clinical stage (Table 1).

Major intraoperative outcomes

D2 radical gastrectomy and the LN dissections were routinely performed in all patients. No malignant tissues were found at the proximal or distal resection margin in any of the patients. Operation time, amount of blood loss, the number of lymph nodes retrieved, incision length, and conversion to laparotomy are shown in Table 2.

We compared the treatment characteristics between the 2 groups (Table 2). Operative time was not significantly different. between the LADG and TLDG groups (183.31 ± 22.66 minutes versus 177.00 ± 26.76 minutes, $P = 0.145$). There were no significant differences in blood loss (188.23 ± 50.23 mL in

Table 2 The comparison of intraoperative data

	LADG, n = 64 (mean ± SD)	TLDG, n = 70 (mean ± SD)	*P* value	t(χ^2)
Operation time, min	183.31 ± 22.66	177.00 ± 26.76	0.145	1.467
Blood loss, mL	188.23 ± 50.23	175.9 ± 53.2	0.171	1.377
Lymph nodes resected, n	37.47 ± 7.95	38.31 ± 5.67	0.477	−0.714
Incision length, mm				
Proximal margin, mm	52.2 ± 7.33	54.48 ± 7.1	0.067	−1.835
Distal margin, mm	48.6 ± 5.98	46.57 ± 6.48	0.062	1.885
Conversion to open surgery, n	4	4	0.896	0.017

Values are presented as mean ± standard deviation or number (%).

Table 3 The comparison of postoperative data

	LADG, (n = 64), (mean ± SD)	TLDG (n = 70), mean ± SD	*P* value	t(χ^2)
Time to the first flatus, h	84.11 ± 12.18	74.09 ± 11.08	<0.001	4.99
Time to liquid diet, h	108.58 ± 13.08	98.83 ± 10.63	<0.001	4.752
Fever, h	50.13 ± 9.81	48.47± 11.90	0.38	0.88
Dosage of pain killers	2.41 ± 0.85	2.01 ± 0.85	0.009	2.652
Hospital stay, d	9.97 ± 4.53	8.14 ± 3.43	0.009	2.643
Complication incidence 0.871				2.301
Anastomotic bleeding or leakage	2	3	0.723	0.125
Wound infection	1	1	0.949	0.004
Respiratory infection	0	1	0.335	0.188
Dysfunction	3	1	0.268	1.226
Thrombosis	0	0		
Death	0	0		

Values are presented as mean ± standard deviation or number (%).

LADG versus 175.9 ± 53.2 mL in TLDG, $P = 0.171$), the number of lymph nodes resected (37.47 ± 7.95 in LADG versus 38.31 ± 5.67 in TLDG, $P = 0.477$), incision length (proximal margin: 52.2 ± 7.33 mm in LADG versus 54.48 ± 7.1 mm in TLDG, $P = 0.067$; distal margin: 48.6 ± 5.98 mm in LADG versus 46.57 ± 6.48 mm in TLDG, $P = 0.062$), There were 4 patients conversion to open surgery separately in both groups with on significantly different ($P = 0.896$).

Postoperative characteristics

Postoperative clinical courses including time to the first flatus, start of liquid diet, fever days, dosage of pain killers, days of postoperative hospital stay, and complication incidence were compared between the 2 groups.

As shown in Table 3, there was no significant differences in fever time (50.13 ± 9.81 hours in LADG versus 48.47 ± 11.90 hours in TLDG, $P = 0.38$). Time to the first flatus (84.11 ± 12.18 hours for the LADG versus 74.09 ± 11.08 hours for the TLDG group, $P < 0.001$) was significantly different. Earlier postoperative liquid diet intake was observed in TLDG compared with the LADG (98.83 ± 10.63 hours versus 108.58 ± 13.08 hours, $P < 0.001$). Compared to the LADG group, the TLDG group showed faster recovery with a shorter postoperative hospital stay (8.14 ± 3.43 days versus 9.97 ± 4.53 days, $P = 0.009$). Dosage of pain killers was significantly less used in the TLDG group than that in the LADG group (2.01 ± 0.85 versus 2.41 ± 0.85, $P = 0.009$).The postoperative complication rate was 9.375% (6 of 64) in the LADG group and 8.57% (6 of 70) in the TLDG group, and there was no significant difference between two groups ($P > 0.05$). No difference was observed in the incidence of thrombosis and death between the LARG and TLDG groups.

Discussion

Surgery remains the major therapeutic approach for gastric cancer. Reports had showed that laparoscopy-assisted D2 radical gastrectomy (LADG) surgery for early gastric cancer (EGC) have showed several advantages of the laparoscopic approach over conventional open surgery, just as less blood loss, less postoperative pain and shorter hospital stay.[12] LADG has been thought as a safe and effective procedure to treat early gastric cancer.[13,14] With the development of laparoscopic technique, totally laparoscopic distal gastrectomy (TLDG) has been introduction for EGC.

Reconstruction of the digestive tract is technically difficult during laparoscopic surgery for EGC. Delta-shaped gastroduodenostomy (DSG) for intracorporeal B-I anastomosis was first reported in 2002.[8] There is no clear conclusion in favor of either LADG or TLDG, and despite favorable results in case series[15,16] a clear-cut benefit for TLDG over LADG has not been established up to now yet.[17]

We performed the delta-shaped B- I anastomosis as the main method for reconstruction during TLDG with delta-shaped anastomosis. and compared 64 patients who underwent conventional LADG and 70 who underwent TLDG in terms of their intra- and postoperative surgical outcomes in short time. The main outcomes were as follows: operative time, blood loss, the number of lymph node resected, incision length of the tissues and fever days after TLDG and LADG were similar; and TLDG were better than LADG in early-term effect, including

postoperative recovery time of intestinal function, just as time to the first flatus and time to liquid diet, postoperative pain, the length of postoperative hospital stay. The incidence of postoperative complications (anastomotic bleeding or leakage, wound infection, digestive tract dysfunction, thrombosis and death) were similar in both groups.

As the surgical view is amplified, laparoscopic surgery can be benefited to preserve the integrity of the dissected lymph nodes and lymph ducts, and remove any associated lymphatic and connective tissues *en bloc* laparoscopic surgery has been accepted as a novel minimally invasive surgical option for EGC patients. However, in LADG, the incision is relatively small, especially in patients with obesity, it was difficult to expose for the successful completion of extracorporeal gastroenteric anastomosis.[18] TLDG was introduced in the hope of overcoming the difficulty of reconstruction, especially on obese. In totally laparoscopic surgery, anastomosis is accomplished in the abdomen. Kim *et al* considered obesity was the potential factor to increase risk on the postoperative complications in LADG, because of small incision and poor exposure for anastomosis .Totally laparoscopic distal gastrectomy can be an effective way of performing laparoscopic gastrectomy in obese patients (BMI $\geq$ 30).[19] We also confirm that TLDG cannot be influenced by obesity without small cut, decrease the risk of wound infection, and bring more benefits for the gastric cancer patients with obesity. TLDG is associated with less morbidity due to postoperative complications and decreased length of postoperative hospital stay.[20]

The use of the ERAS protocol together with laparoscopy aims to achieve quicker recovery after surgery.[21] Most reports improved postoperative outcomes in laparoscopic gastric surgery as a result of enhanced recovery programs. And analgesia plays a fundamental role in postoperative care. Evidence has shown that analgesia is generally sufficient in the case of laparoscopic surgeries.[22,23] In our study, less dosage of painkillers used in TLDG than LADG means earlier effective postoperative mobilization of patients is possible. TLDG without small incision contributes to improve postoperative patients comfort, leading to earlier postoperative mobilization, and decrease the probability of bowel obstruction.

All anastomosis leakages in both groups were well recovered with conservative treatment including digestive tract rest with nutritional support and recovered by percutaneous drainage. In this study, there was no significant difference in surgical complication between LADG and TLDG

Conclusion

In conclusion, this study suggests that the TLDG is one of the safe and feasible procedure for the treatment of early gastric cancer in favor of time to the first flatus, postoperative liquid diet intake, dosage of painkillers and postoperative hospital stay compared with LADG. However, well-designed, large-scale prospective randomized study is needed for proving the real benefits of TLDG.

Acknowledgments

Tao Fu and Wei-Dong J contributed equally to the work. This study was reviewed and approved by the Ethics Committee of the Wuhan General Hospital. Patients were not required to give informed consent to the study because the analysis used anonymous clinical data that were obtained after each patient agreed to treatment by verbal consent. Individuals can't be identified according to the data presented. All data generated or analyzed during this study are included in this published article.

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