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*Original Article*

# Comparison of early-term effects between totally laparoscopic distal gastrectomy with delta-shaped anastomosis and conventional laparoscopic-assisted distal gastrectomy: a retrospective study

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**Abstract:** Objective: To compare early-term effects of totally laparoscopic distal gastrectomy with delta-shaped anastomosis (D-STLDG) with conventional laparoscopic-assisted distal gastrectomy (LADG). Methods: Clinical data of 24 patients who received D-STLDG from April 2013 to April 2014, and 45 patients who received LADG from March 2010 to December 2012 were retrospectively analyzed. The operative time, intra-operative blood loss, post-operative recovery time of intestinal function, post-operative pain, the length of post-operative hospital stay and the incidence of post-operative complications (infection, obstruction and delayed gastric emptying) were compared between the two groups. Results: All procedures were completed successfully and all patients of both groups were discharged smoothly from hospital. Compared with LADG, D-STLDG had shorter operative time (175.3±64.7 min vs. 205.8±42.2 min, P<0.05), less intra-operative blood (50.8±25.3 ml vs. 75.2±22.5 ml, P<0.05), shorter post-operative recovery time of intestinal function (1.2±0.5 d vs. 2.1±0.8 d, P<0.05), less post-operative pain (5.6±0.7 vs. 7.8±0.5, P<0.05), shorter post-operative hospital stay (8.5±2.2 d vs. 10.5±3.5 d, P<0.05). There were no significant difference in surgical margins achieved, the number of lymph nodes retrieved or the incidence of post-operative complications (infection, obstruction and delayed gastric emptying) (P>0.05). Conclusion: The delta-shaped anastomosis of reconstructing the digestive tract in TLDG appears to be safe, feasible and associated to faster recovery.

**Keywords:** Surgery, laparoscope, gastric cancer, delta-shaped anastomosis

## Introduction

Gastric cancer is one of the most common malignancies all around word, and surgery remains the gold standard treatment for locally advanced disease. Since laparoscopic techniques were first reported for early gastric cancer in 1994, they have been used to perform gastrectomies for gastric cancer [1]. The development of laparoscopic devices and increased surgical experience have significantly increased the number of laparoscopic surgeries performed in gastric cancer patients. In the literature, reports of laparoscopic D2 lymph node dissections have shown the extent of lymph node dissection and demonstrated that the technical feasibility of the procedures is equivalent to those of open surgery, with no significant difference in the number of resected lymph nodes [2-4].

For many years laparoscopic distal gastrectomy has been popular as a treatment option for stomach pathologies, particularly for early gastric cancer in eastern Asia. Standard procedures for lymph node dissection and reconstruction in laparoscopic distal gastrectomy have been established [5, 6]. There are two kinds of laparoscopic radical gastrectomy: totally laparoscopic surgery and laparoscopic-assisted surgery [7].

Laparoscopic-assisted gastrectomy, involving the use of laparoscopic surgery and its related

equipment, were developed as a minimally invasive approach and has also been used since its first description in 1999 for treatment of gastric cancer [8, 9]. On the one hand, laparoscopic-assisted gastrectomy has limited field of vision compared to traditional open gastrectomy; on the other hand, compared to traditional open gastrectomy, laparoscopic-assisted gastrectomy can achieve better cosmesis, shorter hospital stay, faster postoperative recovery, and better postoperative quality of life [10-13].

The totally laparoscopic gastrectomy for distal gastric carcinoma, which is characterized by an intracorporeal anastomosis without auxiliary incision and no touching of the tumor, has become the focus of research; it is considered 'incisionless', with the exception of the trocar wounds [14].

The aim of this study was to compare early-term surgical outcomes of patients undergoing totally laparoscopic distal gastrectomy with delta-shaped anastomosis (D-STLDG) with those of patients undergoing conventional laparoscopic-assisted distal gastrectomy (LADG).

## Materials and methods

### *Patients*

A total number of 242 patients received gastrectomy from March 2010 to April 2014. Twenty-four cases underwent totally laparoscopic distal gastrectomy with delta-shaped anastomosis (totally laparoscopic distal gastrectomy with delta-shaped anastomosis group, D-STLDG group) from April 2013 to April 2014, including 16 males and 8 females, 45 -71 years old, and the average age is 64, all of patients were diagnosed with confirmed gastric antrum cancer, and the pre-operative pathological stage is T1-T3. Forty-five cases underwent conventional laparoscopic-assisted distal gastrectomy (laparoscopic-assisted distal gastrectomy group, LADG group) from March 2010 to December 2012, including 31 males and 14 females, 42-76 years old, and the average age is 66, and all cases in this group were diagnosed with confirmed gastric antrum cancer.

### *Surgical procedure*

Abdominal and pelvic cavities were examined through a gastroscope or pre-operative CT scan to locate the tumors. Patients were fully anaesthetized with tracheal intubation, and were placed in supine lithotomy position. The surgeon stood on the left side of the patient, the first assistant surgeon stood on the right side of the patient, and the second assistant surgeon who held the camera stood between the patient's legs. During separation of the splenogastric ligament, the surgeon positioned himself between the patient's legs. The greater omentum was severed by an ultrasound knife along the edge of the colon. The first assistant surgeon lifted the fore-stomach and omentum, and turned the stomach up in the direction of the head. The anterior lobe of the transverse mesocolon was peeled upwards; then, No. 14 lymph nodes along the inferior margin of the pancreas and surface of the head of the pancreas were removed. Subsequently, the right gastric-omentum artery was isolated from other visceral structures, and No. 6 lymph nodes were cleared away at the same time. Then, the right gastro-omental artery and left gastro-omental vein were severed and ligated, respectively. The gastroduodenal artery along the posterior wall of the duodenum was liberated, and the horizontal part of the duodenum was extensively dissected. The first assistant surgeon changed the traction, held the stomach up, and the plica gastropancreatica was subsequently exposed. Then, the splenic artery was exposed and dissected, allowing the removal of Nos. 7, 8, 9 and 11P lymph nodes. The root of the left gastric artery was then isolated and cut off with a hemoclip. No. 1 and 3 lymph nodes were cleared away from the diaphragm perpendicular to the cardia, and the lesser curvature of the stomach was severed. Nos. 5, 8 and 12 lymph nodes were removed along the common hepatic artery. The right vessel of the stomach was then ligated. The stomach was released by the first assistant surgeon, the lower edge of the liver was stretched using a tractor, and 3-5 cm of intestines located between the duodenum and the pylorus was carefully dissected. Subsequently, the surgeon positioned and stood between the patient's legs. Afterwards, the left gastro-omental artery and vein were isolated and cut off with a hemoclip. No. 4sb lymph node was then removed, but care was taken to leave at least three vasa previa vessels *in situ*. The surgeon returned to the left side of the patient. Then, disarticulation of gastro-duodenal resection was carried out with a linear cut stapler at approximately 2 cm

**Table 1.** Comparison of the surgical data between the two groups

| Index | D-STLDG group (n=24) | LADG group (n=45) |
|---|---|---|
| Operative time (min) | 175.3±64.7 | 205.8±42.2* |
| Intra-operative blood loss (ml) | 50.8±25.3 | 75.2±22.5* |
| Recovery time of intestinal function (d) | 1.2±0.5 | 2.1±0.8* |
| Post-operative pain | 5.6±0.7 | 7.8±0.5* |
| Post-operative hospital stay (d) | 8.5±2.2 | 10.5±3.5* |

*P<0.05 vs. D-STLDG group as determined by student's test. D-STLDG group: totally laparoscopic gastrectomy with delta-shaped anastomosis; LADG group: conventional laparoscopic-assisted distal gastrectomy.

**Table 2.** Comparison of surgical margins and the number of lymph node dissections in the two groups

| Index | D-STLDG group (n=24) | LADG group (n=45) | *P* value |
|---|---|---|---|
| Surgical margins (cm) | 4.1 ± 1.5 | 4.9 ± 2.1 | 0.10 |
| Number of lymph node dissections | 23.5 ± 12.2 | 29.2 ± 15.7 | 0.12 |

D-STLDG group: totally laparoscopic gastrectomy with delta-shaped anastomosis; LADG group: conventional laparoscopic-assisted distal gastrectomy.

**Table 3.** Comparison of the incidence of post-operative complications of the two groups

| Index | D-STLDG group (n=24) | LADG group (n=45) | *P* value |
|---|---|---|---|
| Infection | 1/24 (4.1%) | 5/45 (11.1%) | 0.59 |
| Obstruction | 0/24 (0%) | 1/45 (0.2%) | 1.0 |
| Delayed gastric emptying | 0/24 (0%) | 1/45 (0.2%) | 1.0 |

D-STLDG group: totally laparoscopic gastrectomy with delta-shaped anastomosis; LADG group: conventional laparoscopic-assisted distal gastrectomy.

down the pylorus. The resected specimen was collected and stored into a specimen bag. The specimen was removed from the incision (3 cm) of the navel or the main puncture on the left, and resection specimens were checked to make sure that no cancer remained. Then, the incision was closed, pneumoperitoneum was established, and the remnant stomach and duodenum were checked to make sure these were closed and without tension. An incision (2 cm) was cut along the lesser curvature of the duodenum and another incision (3 cm) was cut along the greater curvature of the stomach. The posterior gastric wall and lateral posterior duodenal wall were sutured with a linear cutting stapler (60 mm, Johnson), and the common incision was sutured. Visual inspection was carried out to confirm that there was no bleeding. Then, the peritoneal cavity was lavaged, drainage tubes were applied according to routine procedures, and the pneumoperitoneum was closed.

Furthermore, all 45 patients in the LADG group received gastric resection and lymph node dissection in the laparoscopic, and gastroenteric anastomosis using the circle anastomat outside the abdominal wall, according to established and routine procedures [15].

*Statistical analyses*

Data were expressed as mean ± SD and were analyzed using two-way Student's *t*-test. Statistical analyses were carried out using SPSS v16.0 (SPSS, Chicago, IL, USA). *P*<0.05 was considered significant. Fisher's exact test was used to compare the incidence of post-operative infection, obstruction and delayed gastric emptying between the two groups. *P*<0.05 was considered significant.

## Results

All of the 24 patients of the D-STLDG group received successful surgery in totally laparoscopic surgery, and there was no conversion to laparotomy. Compared with the LADG group (**Table 1**), the operative time of the D-STLDG group (175.3±64.7 min) was shorter than the LADG group (205.8±42.2 min) (P<0.05), intra-operative blood loss (50.8±25.3 ml) was less than the LADG group (75.2±22.5 ml) (P<0.05), the post-operative recovery time of intestinal function (1.2±0.5 d) was shorter than the LADG group (2.1±0.8 d) (P<0.05). Further, the post-operative pain [16] (5.6±0.7) was less than the LADG group (7.8±0.5) (P<0.05), the length of post-operative hospital stay (8.5±2.2 d) was shorter than the LADG group (10.5±3.5 d) (P<0.05).

There was no significant difference in surgical margins achieved or the number of lymph node dissected between the two groups (**Table 2**), with respective *P* values of 0.10 and 0.12. There was also no significant difference in the

incidence of the post-operative complications (infection, obstruction and delayed gastric emptying) between two groups (**Table 3**), and the *P* value was 0.59, 1.0 and 1.0, respectively. There was no fatal complication in both groups. Port hole infection after laparoscopic surgery occurred in one case in the D-STLDG group, which was successfully treated by changing the dressing. Other complications such as bleeding, anastomotic leakage or obstruction, and delayed gastric emptying did not occur.

## Discussion

We compared surgical outcomes of patients with gastric cancer who underwent D-STLDG or conventional LADG. The main findings were as follows: the quality of lymph node dissection after D-STLDG and conventional LADG was similar; and D-STLDG were better than conventional LADG in early-term effect, including operative time, intra-operative blood loss, post-operative recovery time of intestinal function, post-operative pain, the length of post-operative hospital stay. The incidence of post-operative complications (infection, obstruction and delayed gastric emptying) were similar in both groups.

Currently, it has been preliminarily confirmed that LADG is the safety and therapeutic effect [17]. However, in LADG, the incision is relatively small, especially in obese patients, yielding difficulties for the successful completion of extracorporeal gastroenteric anastomosis [18]. Extension of the laparotomy is often necessary to obtain a better view for secure anastomosis following LADG on obese patients. TLDG was introduced in the hope of overcoming the difficulty of reconstruction, especially on obese. In totally laparoscopic surgery, anastomosis is completed inside the abdominal wall and simplifies the procedure; thus, reducing operation time and surgeon workload. This procedure is associated with less morbidity due to post-operative complications and decreased length of post-operative hospital stay. Fully laparoscopic gastroenteric anastomosis remains a challenge to surgeons and is associated with extended operation times. A possible solution was revealed by a study carried out by Kanaya et al. in 2002, describing a fully laparoscopic technique to complete the gastroenteric anastomosis using a linear cutting stapler [19]. Since then, the safety and clinical success of this specific operation has further been improved due to increased practical experience and better equipment.

Our hospital commenced performing this type of procedure in 2012 [20]. We have completed 24 cases of delta-shaped anastomosis of the remnant stomach to the duodenum. Compared to conventional circular anastomosis, the delta-shaped anastomosis is associated with a larger anastomotic area; thus, reducing the risk of anastomotic stenosis and bleeding. The conversion of our experimental procedure allows us to compare the relative performance of delta-shaped anastomosis with the classical approach, and results have been presented in this current study.

The operating safety is a long-standing concern for surgeons performing TLDG. Some researches show that TLDG is not inferior to LADG in terms of the overall safety and the anastomotic-related safety [21, 22]. In our study, although only one patients (4.1%) developed postoperative complications in TLDG team and seven patients (11.5%), there were no significant difference between these two groups. A simple scoring system could accurately predict the risk of postoperative complications after laparoscopic gastrectomy for gastric cancer. The adverse risk factors for overall complications wew as follow: age ≥65 years, body mass index (BMI) ≥28 kg/m$^2$, tumor with pyloric obstruction, tumor with bleeding, an dintra operative blood loss ≥75 mL; age ≥65 years, a Charlson comorbidity score ≥ 3, tumor with bleeding and intraoperative blood loss ≥75 mL were identified as independent risk factors for major complications. If the risk factors were more, the incidence of overall complications were higher. The score might be helpful in the selection of risk-adapted interventions to improve surgical safety [23].

In this study, identifying lesions is one of the main difficulties during surgery, because the cancers involved were relatively in the low/early pathological stages; and localizing the lesion by probing and squeezing by manipulators may release cancer cells in the circulation. For smaller lesions, especially those in cavities, their aspect is difficult to distinguish from visual inspection of the serosa. Thus, guidance by endoscopic investigation is often necessary [24]. Indeed, tumor localization was estab-

lished through this approach in 38 cases in both groups. Following gastric resection, it is important to immediately establish an extended tumor-free margin to avoid the embarrassment of later finding out that the excision extension was insufficient.

In conclusion, we found that D-STLDG is similar to conventional LADG in terms of the quality of lymph node dissection, including the number of dissected lymph nodes and patient safety. Compared to conventional LADG, D-STLDG brings about better cosmesis, and faster postoperative recovery. D-STLDG is a feasible procedure and therefore may be another treatment option for patients with early gastric cancer.

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## Disclosure of conflict of interest

None.

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