Laparoscopy-assisted total gastrectomy with trans-orally inserted anvil (OrVil™): A single institution experience

Guan-Qun Liao, Xiao-Wei Ou, Shi-Qiang Liu, Shao-Rui Zhang, Wen Huang

Guan-Qun Liao, Xiao-Wei Ou, Shi-Qiang Liu, Shao-Rui Zhang, Wen Huang, Department of General Surgery, Foshan Affiliated Hospital of South Medical University, Foshan 528000, Guangdong Province, China

Author contributions: Liao GQ and Ou XW conceived the study; Liao GQ, Liu SQ, Zhang SR acquired and interpreted the data; Liao GQ drafted the manuscript; all authors were involved in patient treatment and approved the final version of the paper.

Correspondence to: Xiao-Wei Ou, Chief, Professor, Department of General Surgery, Foshan Affiliated Hospital of South Medical University, Foshan 528000, Guangdong Province, China. ouxiaowei126.com
Telephone: +86-757-88032138 Fax: +86-757-88032137
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Abstract

AIM: To investigate the feasibility of laparoscopy-assisted total gastrectomy (LATG) using trans-orally inserted anvil (OrVil™) in terms of operative characteristics and short term outcomes.

RESULTS: Characteristics of 27 patients with gastric cancer who underwent LATG from October 2009 to October 2012 in the Foshan Affiliated Hospital of South Medical University were retrospectively reviewed. Among these patients, six were reconstructed by mini-laparotomy and 21 by OrVil™. The clinicopathological characteristics, total operation time, total blood loss, abdominal incision and complications of anastomosis including stenosis and leakage, were compared between the groups undergoing LATG with OrVil™ and the group undergoing mini-laparotomy.

RESULTS: The operations were successfully performed on all the patients without intraoperative complications or conversion to open surgery. Two (10%) patients were prepared for LATG preoperatively. One case had hepatic metastatic carcinoma and 1 case had tumor recurrence near the anastomosis 8 mo after surgery. The mean follow-up duration was 10 mo (range, 2-24 mo). Operation time was significantly reduced by the use of OrVil™ (198.42 ± 30.28 min vs 240.83 ± 8.23 min). The postoperative course with regard to occurrence of stenosis and leakage was not different between the two groups. There were no significant differences in estimated blood loss. The upper abdominal incision was smaller in OrVil™ group than in mini-laparotomy group (4.31 ± 0.45 cm vs 6.43 ± 0.38 cm).

CONCLUSION: LATG using OrVil™ is a technically feasible surgical procedure with sufficient lymph node dissection, less operation time and acceptable morbidity.

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Key words: Total gastrectomy; Esophagojejunostomy; Laparoscopy-assisted total gastrectomy; Reconstruction; OrVil™

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INTRODUCTION

Laparoscopic gastrectomy (LG) including laparoscopy-assisted gastrectomy (LAG) and totally LG with regional lymph node dissection as an alternative surgical treatment for gastric cancer has become increasingly common worldwide, especially in Asia[1-3]. However, laparoscopy-assisted total gastrectomy (LATG) has not been
accepted as widely as other LGs because of the low incidence of gastric cancer requiring LATG and because it is particularly difficult even for some experienced surgeons to perform\cite{4,5}. Nevertheless, comparing with the conventional open total gastrectomy, laparoscopic surgery as an advanced procedure offers the advantages of less invasiveness and the same curability if surgeons are adroit at performing LATG\cite{6,7}.

Since 2009, our institution has adopted laparoscopic modalities for both the early and advanced stage gastric cancer patients, including 27 cases of LATG. Herein, we review our experience with LATG and analyze the results of LATG in terms of operative characteristics and short-term outcomes.

**MATERIALS AND METHODS**

**Patients**

We retrospectively reviewed a series of 27 patients who underwent LATG between October 2009 and October 2012. Twenty-one of them were reconstructed by trans-orally inserted anvil (OrVil\textsuperscript{TM}) and six by mini-laparotomy. The mini-laparotomy was performed in relatively early period and set for the comparisons of short-term outcomes.

Preoperative tumor node metastasis (TNM) stage was determined in all the patients according to the International Union Against Cancer (UICC, 7th edition) and based on endoscopic biopsy and abdominal computed tomography. The indication for LATG in gastric cancer was limited to preoperative stage T\textsubscript{1-2}N\textsubscript{0-1}M\textsubscript{0}. Patients whose NRS 2002 score was more than 4 received more than 1 wk nutrition therapy before operation. Patients suitable for endoscopic submucosal dissection or had surgical contraindications were excluded. Written informed consent was signed by each patient who agreed to undergo LATG.

**Surgical procedure**

All patients were placed in relaxed dorsal lithotomy position. The surgeon usually stood on the left side of the patient, the first assistant surgeon on the right, and the second assistant surgeon holding the camera stood between the patient’s legs. At the beginning, five trocars were introduced into the right upper quadrant (5 mm), right middle quadrant (5 mm), subumbilical (10 mm; camera port), left middle quadrant (5 mm), and left upper quadrant (12 mm) regions of the abdomen. The intra-peritoneal pressure was maintained as 12 mmHg with carbon dioxide.

Total gastrectomy with complete omentectomy and extended lymphadenectomy (D2) was performed in all the patients. After sufficient mobilization of the duodenum near the pylorus ring and abdominal esophagus, the duodenum and esophagus were transected using EndoGIA\textsuperscript{TM} Universal stapler (60 mm; Covidien). The stomach was bagged in an isolation pocket and pulled out extracorporeally through a 4-6 cm upper midline incision. In the next step, the gastrointestinal continuity was restored in a Roux-en-Y mode extracorporeally through the incision.

The OrVil\textsuperscript{TM} orogastric tube was transorally introduced into the esophagus. The orogastric tube was then used to make a small hole on the middle of the abdominal esophageal stump. The tube was pulled out into the abdominal cavity through the hole until the anvil reached the esophageal stump. The orogastric tube was disconnected from the anvil and taken out of the esophagus. Subsequently, intracorporeal stapling esophagojejunostomy was performed and the jejunal stump was intracorporeally sutured with EndoGIA\textsuperscript{TM} Universal (Figure 1). The intraperitoneal chemohyperthermia was performed and two drains were placed around the esophagojejunal anastomosis and pelvic cavity, respectively.

**Postoperative course**

The theory of fast track surgery is prevalent in our institution, but we adopt a conservative approach for the LATG patients postoperatively. The preoperatively inserted nasogastric tube for air decompression was removed at the end of surgery. A soft diet commenced orally on postoperative day (POD) 4, and abdominal drain tube was removed after 1 or 2 d when the drainage was less than 30 mL per 24 h. After a meglumine diatrizoate meal examination of esophago-intestinal tract was performed to evaluate anastomotic leakage and stenosis on PODs 8 to 10, patients were discharged on PODs 10 to 13.

**Statistical analysis**

Data were analyzed by the SPSS statistical software (SPSS 13.0). Quantitative variables were compared using the Student’s t test and were expressed as means ± SD. P values were considered to be statistically significant at 0.05.

**RESULTS**

**Patient characteristics**

Patient characteristics including age, gender, body mass index (kg/m\textsuperscript{2}), history of abdominal surgery, NRS 2002 score and comorbidities are listed in Table 1. The operations were successfully performed in all the patients, without intraoperative complications or conversion to open surgery. Two (10%) cases received palliative procedure under laparoscope who were prepared for LATG preoperatively. One case developed hepatic metastatic carcinoma and 1 case had tumor recurrence near the anastomosis 8 mo after surgery. Mean follow-up duration was 10 mo (range, 2-24 mo).

**Surgical procedure**

Table 2 shows the surgical outcomes and postoperative complications. All patients underwent LATG with antecolic type Roux-en-Y esophagojejunostomy and D2
lymph node dissection. One case received combined spleen and pancreatic tail resection. Operation time was significantly reduced by the use of OrVil™ (198.42 ± 30.28 min vs 240.83 ± 8.23 min, P < 0.05). The postoperative course with regard to stenosis and leakage did not differ between the two groups. There were no significant differences in estimated blood loss (130.57 ± 65.17 mL vs 140.83 ± 78.41 mL, P > 0.05). The upper abdominal incision was smaller in OrVil™ group than in mini-laparoscopy group (4.31 ± 0.45 cm vs 6.43 ± 0.38 cm, P < 0.05).

**Postoperative course**

The mean time to first oral intake and postoperative hospital stay were 3.2 d (range, 2-5 d) and 12.5 d (range, 10-19 d). Anastomotic stenosis and major leakage occurred in one case, respectively. All the patients were evaluated at over stage I and received adjuvant chemotherapy.

**Tumor characteristics**

Histologically, 13 patients had poorly differentiated carcinoma and 3 patients had signet ring cell carcinoma. The mean tumor size was 4.5 cm (range, 3.2-7 cm). The location of the tumor was the upper body in 7 patients and the mid body in 11 patients. Esophageal invasion was detected in 1 patient and double lesions were detected in 1 patient who had a mid-body cancer. The mean length of proximal resection margin was 4.7 cm (range, 2.2-6.1 cm) and the distal one was 6.2 cm (range, 3.1-9 cm). TNM staging according to the 7th UICC identified stage II A in 2, stage II B in 7, stage III A in 6, stage III B in 5 and stage III C in 1 patient. The mean number of retrieved lymph nodes was 22.4 (range, 16-42). Multiple lymph node metastases were detected, 1-2 lymph nodes in 2 patients, 3-6 in 8 patients and more than 7 in 11 patients.

**DISCUSSION**

Since the first report of LG in 1992[8], LAG has been carried out not only in distal and proximal gastrectomy, but also in total gastrectomy which was more often used in advanced gastric cancer[9-11]. Although performance of LATG for gastric cancer has been increasing worldwide, especially in Asia, it remains controversial if laparoscopic

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Figure 1  Esophagojejunostomy with trans-orally inserted anvil. A: The trans-orally inserted anvil orogastric tube was transorally introduced into the esophagus (white arrow); B: The tube was pulled out into the abdominal cavity through the hole. The black arrow shows the place to be separated; C: The orogastric tube was disconnected from the anvil and intracorporeal stapling esophagojejunostomy was performed.

| Case | Gender | Age (yr) | NRS score | BMI  | Previous abdominal operation | Comorbidity                        |
|------|--------|----------|-----------|------|------------------------------|------------------------------------|
| 1    | Female | 46       | 5         | 27.2 | No                          | Urinary lithiasis                  |
| 2    | Male   | 77       | 7         | 24.1 | No                          | No                                 |
| 3    | Male   | 65       | 8         | 21.4 | Appendectomy                 | No                                  |
| 4    | Male   | 61       | 4         | 26.4 | No                          | No                                  |
| 5    | Male   | 62       | 5         | 22.1 | Cholecystotomy               | No                                  |
| 6    | Female | 71       | 8         | 20.9 | No                          | Gout; high blood pressure          |
| 7    | Male   | 48       | 5         | 24.4 | No                          | No                                  |
| 8    | Male   | 62       | 5         | 23.7 | Cesarean section            | Hepatic cyst; high blood pressure; cholecystolithiasis |
| 9    | Male   | 60       | 2         | 23.8 | No                          | No                                  |
| 10   | Female | 55       | 2         | 23.2 | No                          | No                                  |
| 11   | Female | 52       | 8         | 17.4 | Cesarean section            | No                                  |
| 12   | Male   | 70       | 2         | 21.5 | No                          | No                                  |
| 13   | Male   | 54       | 3         | 20.5 | No                          | Urinary lithiasis; urinary infection |
| 14   | Male   | 42       | 7         | 18.8 | Gastrectomy                 |                                     |
| 15   | Male   | 72       | 3         | 24.8 | No                          |                                     |
| 16   | Male   | 61       | 6         | 22.1 | No                          | High blood pressure                |
| 17   | Female | 63       | 2         | 20.8 | Appendectomy                |                                     |
| 18   | Male   | 66       | 5         | 19.2 | No                          |                                     |
| 19   | Male   | 70       | 2         | 21.5 | No                          |                                     |
| mean | NA     | NA       | NA        | NA   | NA                          |                                     |

BMI: Body mass index; NRS: Nutritional risk screening (2002); NA: Not available.
D2 dissection is equivalent to open surgery for advanced gastric cancer (AGC). In our cases, the dissection of more than 15 lymph nodes was performed and the final cutting edge negative rate was 100%. Some recent studies focus on the outcome of D2 lymph node dissection in LAG and open surgery for gastric cancer. Du et al. evaluated 82 patients with AGC who underwent LATG with D2 dissection compared with 94 patients who received open surgery; a similar number of harvested lymph nodes (HLNs) was obtained in both groups. Cui et al. retrospectively analyzed 131 cases including a single LATG group, and found that laparoscopic D2 dissection is equivalent to open gastrectomy in the number of HLN, regardless of tumor location.

The mean operation time for LATG with OrVil was 198 min, which was significantly shortened compared with the traditional mini-laparotomy group (240 min), and the mean operation time for LATG was also significantly shorter than for mini-laparotomy (180 min vs 406 min) in the previous studies. It takes a longer time to perform esophagogastrojunal anastomosis through a narrow mini-laparotomy in LATG, which can be avoided by the use of OrVil. The same conclusion is confirmed by other operative team and with OrVil, their mean operation time was 152-243 min which mainly affected by tumor stage.

The incidence of postoperative complications in patients who underwent LATG has been reported to be 9.4%-39.4%, and common complications include anastomotic leakage, anastomotic stenosis, and pancreatic fistula. Some studies revealed that the incidence of complications in the LATG group was similar to that in the open total gastrectomy group; however, other studies showed a lower or higher rate of complications in the LATG group. In this study, 1 case developed anastomotic leakage and 1 case had anastomotic stenosis. The complication rate was 27%, being slightly lower compared with those from previous studies. The high frequency of anastomotic complications in patients who underwent LATG might result from the excessive traction of the distal esophagus and the extensive mobilization of the jejunal limb. In our series, the rates of complications associated with anastomosis were not statistically different between the LATG with OrVil and traditional mini-laparotomy groups. However, it should be mentioned that the number of the mini-laparotomy group was small which may produce statistics bias. The same procedure was performed postoperatively in these two groups, so the comparison of mean time to first oral intake and postoperative hospital stays was meaningless.

There are some reconstructive methods used after LATG, such as Roux-en-Y esophagojunostomy, and extracorporeal or intracorporeal anastomosis using a hand-sewn, circular stapler, or side-to-side linear stapler. Roux-en-Y esophagojunostomy by extracorporeal anastomosis through a small skin incision is the most common approach. However, it is difficult to perform through a mini-laparotomy, particularly on obese patients, and too larger laparotomy makes it similar to conventional open surgery. OrVil as an intracorporeal circular stapling esophagojunostomy can simplify the reconstruction procedure after total gastrectomy. This device requires no purse-string sutures and offers wide intracorporeal operating views. In this study, compared with control group, the smaller body incision and less operation time were observed. Moreover, two respective studies concluded that this technique was simple, safe, and efficient for performing gastrojejunostomy, and additionally less expensive and accelerated the surgical learning curve. However, the earlier studies reported postoperative infection and recommended oral gorging with hexamidine solution and abdominal irrigation after anvil insertion. No postoperative abdominal infection occurred in our series.

There were some limitations in this study. First, this retrospective analysis might have selection bias as a result of comparison of these nonrandomized groups with a retrospective profile. Second, there was no survival data. Thus, long-term oncological outcomes of LATG with OrVil need to be evaluated by future studies. Third, the sample size of the mini-laparotomy group is small and the operation was performed in relatively early period which cause the learning curve effect.

In conclusion, LATG using OrVil for gastric cancer may be a technically feasible surgical procedure with advantages of sufficient lymph node dissection, less operation time and acceptable morbidity. However, the number of patients is small in this study. It will be necessary to confirm these results by a large cohort study in the validity of LATG with OrVil.

**COMMENTS**

**Background**

Laparoscopic gastrectomy (LG) including laparoscopy-assisted gastrectomy (LAG) and totally LG with regional lymph node dissection as an alternative surgical treatment for gastric cancer has become increasingly common worldwide, especially in Asia.

**Research frontiers**

Since the first report of LG in 1992, laparoscopy-assisted gastrectomy has been carried out not only in distal and proximal gastrectomy, but also in total gastrectomy which was more often used in advanced gastric cancer. Although performance of laparoscopic-assisted total gastrectomy for gastric cancer has
been increasing worldwide, especially in Asia, it remains controversial if laparoscopic D2 dissection is equivalent to open surgery for advanced gastric cancer. **Innovations and breakthroughs**

LATG using orally inserted anvil (OrVil™) for gastric cancer may be a technically feasible surgical procedure with advantages of sufficient lymph node dissection, less operation time and acceptable morbidity. However, the number of patients is small in this study. It will be necessary to confirm these results by a large cohort study in the validity of LATG with OrVil™.

**Peer review**

This is an interesting manuscript on LG with trans-orally anastomosis. Since little is known about this technique, many readers would be interested to learn this experience.

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