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BRIEF ARTICLE

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

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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 received palliative procedure under laparoscope who 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.

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[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[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 transorally inserted anvil (OrVil™) 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 $T_{1-4}N_{0-3}M_0$. 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 intraperitoneal 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™ 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™ 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™ 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^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

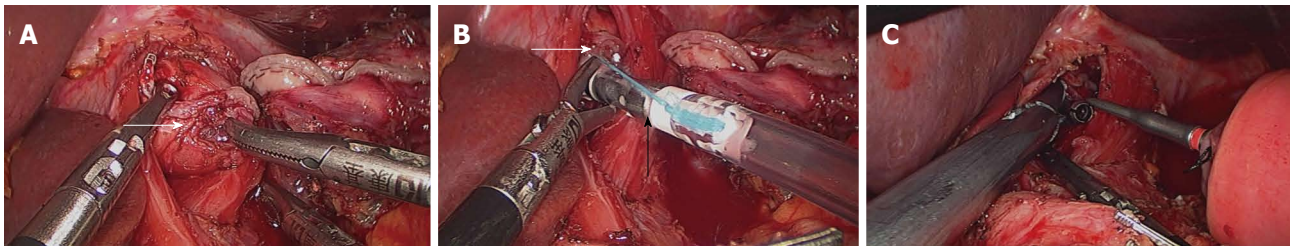

Figure 1 Esophagojejunostomy with trans-orally inserted anvil. A: The trans-orally inserted anvil orogastric tube was transorally introduced into the esophagus (white arrow); B: The tube was pulled out into the abdominal cavity through the hole. The black arrow shows the place to be separated; C: The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

Table 1 Characteristics of patients

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
9	Male	62	5	23.7	Cesarean section	Hepatic cyst; high blood pressure; cholecystolithiasis
10	Male	60	2	23.8	No	No
11	Female	55	2	23.2	No	No
12	Female	52	8	17.4	Cesarean section	No
13	Male	70	2	21.5	No	No
14	Male	54	3	20.5	No	Urinary lithiasis; urinary infection
15	Male	42	7	18.8	Gastrectomy	
16	Male	72	3	24.8	No	
17	Male	61	6	22.1	No	High blood pressure
18	Female	63	2	20.8	Appendectomy	
19	Male	66	5	19.2	No	
mean	NA				NA	NA

BMI: Body mass index; NRS: Nutritional risk screening (2002); NA: Not available.

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* 6.43b ± 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 ⅡA in 2, stage ⅡB in 7, stage ⅢA in 6, stage ⅢB in 5 and stage ⅢC 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

Table 2 Comparisons of characteristics between trans-orally inserted anvil group and mini-laparotomy group

	OrVil™ group (n = 21)	Mini-laparotomy group (n = 6)	P value
Total operation time (min)	198 (180-320)	240 (230-290)	0.018
Total blood loss (mL)	130 (100-400)	140 (100-300)	0.211
Abdominal incision (cm)	4.3 (4-6)	6.4 (5.5-7.0)	0.022
Complications of anastomosis	2	0	1.000
Stenosis	1	0	1.000
Leakage	1	0	1.000

In square brackets: Range. OrVil™: Trans-orally inserted anvil.

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[11-13]. Du *et al*[11] 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*[13] retrospectively analyzed 131 cases including a single LATG group, and found that laparoscopic D2 dissection is equivalent to open gastrectomy in the number of HLNs, 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[9,10,13]. It takes a longer time to perform esophagojejunal 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[3,5,9,14].

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[9,2,14,15]. 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[15-17]. 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[15,18,19]. 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 statitistically different between the LATG with OrVil™ and traditional mini-laparoscopy 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 esophagojejunostomy, and extracorporeal or intracorporeal anastomosis using a hand-sewn, circular stapler, or side-to-side linear stapler[1,9,20,21]. Roux-en-Y esophagojejunostomy 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[22]. OrVil™ as an intracorporeal circular stapling esophagojejunostomy can simplify the reconstruction procedure after total gastrectomy[23]. This device requires no purse-string sutures and offers wide intracorporeal operating views[24,25]. 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[23,26,27]. However, the earlier studies reported postoperative infection and recommended oral gargling with hexamidine solution and abdominal irrigation after anvil insertion[9,28]. 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 laparoscopy-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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