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Original Article

Intracorporeal esophagojejunostomy using the transorally inserted anvil (OrVil) after laparoscopic total gastrectomy for upper gastric cancer

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Abstract: Background: Totally laparoscopic distal gastrectomy gained wide popularity in recent years. Laparoscopic total gastrectomy with intracorporeal esophagojejunostomy (LTGIE) is much less performed. In this study, we reported our preliminary experience of LTGIE using the transorally inserted anvil (OrVil). Methods: Clinical data of patients with upper gastric cancer who underwent LTGIE from January 2016 to January 2017 were retrospectively collected. The operative time, intraoperative blood loss, postoperative recovery time of intestinal function, the length of hospitalization and postoperative complications were summarized and compared between early and later cases. Results: There were totally 26 patients underwent LTGIE using OrVil successfully. The mean total operation time and esophagojejunostomy time was 272.8 min and 45.3 min. The mean estimated blood loss was 113.8 ml. The mean first flatus time was 3.1±0.9 days and the postoperative length of hospitalization (LOH) was 13.0±6.4 days. Three patients suffered postoperative complications, including one abdominal fluid collection, one pulmonary embolism and one pulmonary infection. During the follow-up period, neither local recurrence nor anastomosis-related morbidity was observed. Conclusions: The LTGIE using OrVil is feasible and safe for upper gastric cancer. These preliminary results warrant further evaluation in a larger population to validate.

Keywords: Laparosocopy, gastric cancer, total gastrectomy, transoral, OrVil

Introduction

Laparoscopic gastrectomy with adequate lymphadenectomy has gained wide popularity and is recognized as a preferable alternative to open gastrectomy. Laparoscopic gastrectomy improves surgical outcomes such as milder surgical trauma, alleviated pain, faster bowel recovery and better cosmesis [1-4]. Till now the mainstay of laparoscopic gastrectomy is laparoscopic distal gastrectomy. For upper gastric cancer, laparoscopic total gastrectomy is uncommonly performed due to the technical difficulties in lymphadenectomy and reconstruction of alimentary tract.

Recently, laparoscopic total gastrectomy is gradually performed owing to the accumulation of laparoscpic experience and the evolution of surgical instruments. Short-term surgical outcomes of LTG are superior to its open counterparts as demonstrated by several retrospective studies and meta-analyses [5-8]. Meanwhile, the oncological outcomes of LTG are not inferior. To consummate the minimally invasive advantages of laparoscopic gastrectomy, Surgeons attempted totally laparoscopic gastrectomy, namely completing both resection and reconstruction totally intracorporeally. Ji et al. reported totally laparoscopic distal gastrectomy using delta anastomosis is performed safely and achieved better surgical outcomes than conventional laparoscopic distal gastrectomy [9]. However, laparoscopic total gastrectomy with intracorporeal esophagojejunostomy remains unsettled and only reported by limited studies [10-13]. Surgeons have diverse opinions about the methods of intracorporeal esophagojejunostomy. More clinical experience is still demanding to make steady progress in determining the optimal surgical approach. In our center, we have reported several methods

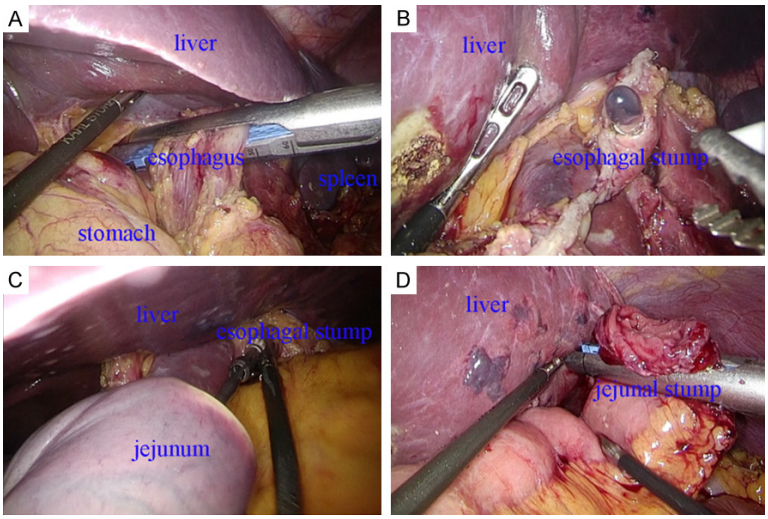

Figure 1. Intracorporeal esophagojejunostomy using OrVil technique. A: Dissection of the esophagus; B: Introducing the OrVil anvil; C: Conjoining the anvil to the central rod and firing; D: Closure of the jejunal stump.

Table 1. Clinicopathologic characteristics of the patients

Variable	Value
Age, y	64.4±4.9
Gender, M/F	16/10
BMI, kg/m^2	23.4±6.3
ASA, I/II/III	13/10/3
Comorbidity, yes/no	13/13
Tumor location	26
Cadia	8
Gastric fundus	12
Gastric body	6
Tumor stage, I/II/III	7/3/16
Tumor size, cm	4.8±0.4

y year, M male, F female, BMI body mass index.

of intracorporeal esophagojejunostomy using conventional circular staple, linear staple or hand sewn technique [14]. Recently, we introduced the transorally inserted anvil (OrVil). Herein, we reported the surgical outcomes and our experience of this technique aiming to evaluate the feasibility and safety of this technique.

Methods

Twenty-six patients accepted laparoscopic total gastectomy with OrVil in Sir Run Run Shaw Hospital from January 2016 to January 2017. These patients were preoperatively confirmed with gastric cancer by histopathological examination. Clinicopathologic characteristics and surgical outcomes of these patients were collected prospectively and maintained by a standard electronic database. Clinical and pathologic staging were classified according to the American Joint Committee on Cancer (seventh edition) and TNM classification. Written consents were signed preoperatively by all the patients. This study was approved by the Review Board of Sir Run Run Shaw Hospital, Zhejiang University.

Sugical technique

The surgical technique of laparoscopic gastrectomy and lymphadenectomy were similar to the method we described before. Briefly, patient position was in the supine position. The five trocars were inserted in a V-shape arrangement. Mobilization of the stomach and en bloc systematic lymph node dissection with spleen preservation were performed using harmonic scalpel under a pneumoperitoneum. D2 lymphadenectomy was applied according to the Gastric Cancer Treatment Guidelines 2011 by the Japanese Gastric Cancer Association [15]. The duodenal bulb and the distal esophagus were transected using a linear stapler (**Figure 1A**).

A small hole was created at the esophageal stump. Next, an anesthetist assisted to insert the tube of the anvil (OrVil™) transorally (**Figure 1B**). The tip of the tube was slowly dragged laparoscopically after it passed through the small hole at the esophageal stump. When the anvil rod reached the esophageal stump and fixed in proper position, the thread connecting the tube and anvil was cut. Then the entire specimen was extracted through a 3- to 5-cm minilaparotomy incision extending to the umbilical port site. The jejunum was transected 15 cm away from the Treitz's ligament using a linear stapler. The circular stapler was introduced into the jejunum through the jejunal stump, attached with the anvil and fired (**Figure 1C**). The jejunal stump was closed with endoscopic linear stapler (**Figure 1D**).

Table 2. Surgical results of the patients

Variable	Value
Operation time, min	272.8±36.2
Esophagojejunostomy time, min	45.3±10.1
Estimated blood loss, ml	113.8±63.2
Number of retrieved lymph nodes	36.9±15.7
Proximal margin, cm	5.3±3.8
Time to first flatus, d	3.1±0.9
Time to first oral intake, d	5.9±2.2
Length of hospitalization, d	13.0±6.4
Length of hospitalization without complications, d	11.2±1.8
Overall postoperative complication, n	3
Abdominal fluid collection	1
Pulmonary embolism	1
Pulmonary infection	1

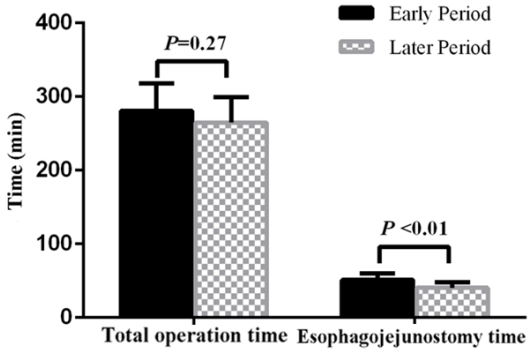

Figure 2. Comparison between the early period cases and the later period cases.

Postoperative management and follow-up

Our center adopted a standard protocol of the postoperative management for patients underwent laparoscopic gastrectomy. Nasogastric tubes routinely are unused except that the patients have high risks of leakage. Good postoperative analgesia, early ambulation, and early oral feeding are encouraged. The patients are allowed to discharge if they fulfill the following criteria: total oral diet without intravenous nutritional support; no fever, no nausea or vomiting, and good flatus and/or defecation; no pain, or controllable using oral analgesics; no drainage tubes or catheters. All the patients were followed by telephone and outpatients service after discharge. Follow-up was usually monthly for the first year, intervals of three months for the second year and intervals of half a year for further follow-ups.

Data analysis

The measurement data are represented as the means ± standard deviations (SDs). Comparisons between early period cases and later period cases were performed using Student' s t test and variance analysis. All statistical tests were two-tailed, and a value of $P<0.05$ was considered statistically significant. The data were analyzed with SPSS 19.0 software (SPSS, Inc., Chicago, IL, USA).

Result

The clinicopathologic features of the patients are shown in **Table 1**. There were 26 patients underwent LTG with OrVil successfully, including 16 males and 10 females. The mean age was 64.4 years old. The mean BMI was 23.4 kg/m^2. Twelve patients were with gastric cancer locating at the gastric funds, eight were at the cardia and six was at the gastric body. According to the AJCC tumor stage classification, seven patients were in stage I, three patients were in stage II, and sixteen patients were in stage III.

The surgical outcomes are summarized in **Table 2**. The mean total operation time and esophagojejunostomy time was 272.8 min and 45.3 min. The mean estimated blood loss was 113.8 ml. The mean first flatus time was 3.1±0.9 days and the postoperative length of hospitalization (LOH) was 13.0±6.4 days. In patients without postoperative complications, the mean LOH was 11.2±1.8 days. Three patients suffered postoperative complications, including one abdominal fluid collection, one pulmonary embolism and one pulmonary infection. All the patients suffering were treated with conservative therapy and recovered well. The median follow-up was 7 months (3 to 14 months). During the follow-up period, neither local recurrence nor anastomosis-related morbidity was observed.

We divided the 26 patients into two groups, the early period group (n=13) and the later period group (n=13). As showed in **Figure 2**, the later period group had favored esophagojejunostomy time (early *versus* later, 51.2±9.1 *versus* 40.4±7.6 min, P<0.01). total operation time

was also less in later period group but without statistical difference (early *versus* later, 280.8±37.2 *versus* 264.8±3.4 min, P<0.01).

Discussion

Unlike the common application of laparoscopic distal gastrectomy, LTG is significantly challenging and less performed. Performing a proper purse-string suture at the esophageal stump and placing an anvil into the esophageal lumen securely are quite difficult through mini-laparotomy. For obese patients, or the big configuration, these procedures become more troublesome. Some reports have introduced placement of anvil intracorporeally, which is high technical expertise demanding and hard to be generalized [12, 16, 17]. To avoid the problem, esophagojejunostomy using a linear stapler is recommended in several reported, including side to side anastomosis [18, 19], functional end to end anastomosis [13, 20] and the overlap anastomosis [21, 22]. But there are some deficiencies in application of these techniques. Linear stapler requires a pretty long esophageal stump which is difficult to assure enough surgical margin on the other hand. Esophageal stump might slip into thoracic cavity when grasp by linear stapler. Another concern lies in the mortal esophagojejunostomy leakage. The rates of esophagojejunostomy leakage in previous reports were significant (3~6%) [18, 22], much higher than that using circular stapler (0.4~2.2%) as historical reports [6, 23, 24].

In present study, we reported our preliminary experience of LTGIE using OrVil. This device has no need of purse string sutures and offers wide operating views. We performed LTGIE 26 patients successfully. The mean esophagojejunostomy time in our study is about 45 min. Wang et al. reported similar mean anastomotic time in a series of 42 cases [25]. Of course, this result is inferior to conventional open approach due to some important factors such as learning curve of both surgeons and anesthetists, meticulous manipulation of laparoscopic instruments, and in our later case the anastomotic time reduced gradually.

Anastomotic leakage and stenosis are critical complications. In our study, there's no case of anastomotic leakage. Secured placement of anvil and improved surgical view during esophagojejunostomy contribute to avoid deficient site on the anastomosis and subsequent leakage. Moreover, the esophagojejunostomy is performed in suit and protects the surrounding structure. Several studies reported double stapling technique was associated with high risk of stenosis [26, 27]. Zuiki et al. argued ischemia at the site where the staple lines meet may lead to fibrosis and could be involved in the development of anastomotic stenosis [27]. There was no patient developing stenosis in our study. We conventionally using 25 mm anvil to get an adequate anastomotic stoma. Stenosis can develop in a later period after operation and some cases performed recently had potential occurrence of stenosis.

In this study, all the cases were cataloged into two groups (early period group and later period group). In later cases, the total operation time reduced nearly 20 min and anastomotic time reduced nearly 10 min. The operation time appeared to reach a plateau at about 260 to 280 min in later period. Learning curve of laparoscopic distal gastrectomy was reported about 30~60 cases [28-30]. Similarly Jeong et al. reported when they accomplished near 45 cases of laparoscopic total gastrectomy, they reached a stable surgical status [31]. Adoption of this new technique by our surgical team is quite enhanced. Accumulation of abundant expertise in conventional laparoscopy-assisted gastrectomy and a regular surgical team with standard operation protocol may be the major factor. Another possible explanation is that we just reach a 'intermediate phase' [30], and after we improve our surgical technique we will reach a 'true plateau'.

Conclusion

Laparoscopic total gastrectomy using the OrVil can be safely performed with acceptable anastomotic complications. This technique can be rapidly adopted by surgeons experienced in minimally invasive surgery.

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Disclosure of conflict of interest

None.

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