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Master of Medicine

Overlap method versus functional method for esophagojejunal reconstruction using totally laparoscopic total gastrectomy

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Overlap method versus functional method for esophagojejunal reconstruction using totally laparoscopic total gastrectomy

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by

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Overlap method versus functional method for esophagojejunal reconstruction using totally laparoscopic total gastrectomy

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ENGLISH ABSTRACTS

AIM

To determine the optimal method of laparoscopic intracorporeal esophagojejunal reconstruction by comparing overlap and functional methods for gastric cancer treatment.

METHODS

We retrospectively collected and analyzed the data of 490 consecutive patients who underwent totally laparoscopic total gastrectomy (TLTG) using the overlap method (125 patients) and functional method (365 patients) as treatment for upper body gastric cancer between January 2011 and May 2018. One-to-one propensity score matching (PSM) was performed to compare age, sex, body mass index, American Society of Anesthesiologist score, presence of comorbidity, number of comorbidities, clinical T stage, clinical nodal stage, clinical TNM stage, history of previous abdominal surgery, and combined surgery. After PSM, patients (122 who underwent TLTG using the overlap method and 122 underwent TLTG using the functional method) were grouped to compare surgical outcomes including esophagojejunostomy (EJ)-related complications.

RESULTS

Pain score was significantly lower after the overlap method (functional method [6.73±2.06] vs overlap method [6.25±1.84], $P<0.05$). However, no statistically significant difference was found between the two groups in terms of other early surgical outcomes such as operative time, time to first flatus, hospital day after surgery, transfusion during surgery, transfusion after surgery and administration of analgesics. TLTG using the overlap method was shown to be associated with significantly fewer EJ-related complications (functional method [n=8, 6.56%] vs overlap method [n=1, 0.82%], $P<0.05$), fewer late complications (overlap method [n=4, 3.28%] vs functional method [n=15, 12.30%]), and lower Clavien–Dindo classification grade than TLTG using the functional method ($P<0.05$).

CONCLUSION

The overlap method should be considered a safe and feasible esophagojejunal reconstruction method, being associated with fewer EJ-related complications than the functional method in TLTG.

Key words: Laparoscopic surgery, Total gastrectomy, Esophagojejunostomy, Gastric cancer, Complication.

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INTRODUCTION

Owing to the worldwide expansion of screening tests, the detection of gastric cancer has increased significantly [1-4]. As a result, there has been a growing attention on intracorporeal anastomosis in laparoscopic gastrectomy and an increased interest in minimally invasive treatments for upper body gastric cancer. However, TLTG is considered a technically challenging procedure because intracorporeal esophagojejunostomy (EJ) is extremely complicated [5]. To overcome such obstacles, various types of intracorporeal esophagojejunal reconstruction methods using a circular or a linear stapler have been implemented. However, there is no well-established anastomosis method for EJ in TLTG [6-9].

Okabe et al. first reported intracorporeal EJ using a linear stapler or the functional method. This novel method substantially reduced the technical difficulties of TLTG and presented a secure and easy way to perform intracorporeal EJ in laparoscopic surgery [10]. However, this method has disadvantages such as requirement of extensive mobilization of the jejunal limb to reduce the tension of the anastomosis and possible kinking of the efferent loop in the hiatal area. In contrast, the overlap method, which was performed by Inaba et al. for the first time, has several advantages including change in the direction of the jejunal limb to alleviate tension at the anastomosis. This modification was suggested to reduce the incidence of postoperative complications, such as anastomotic leakage and stricture. Indeed, several investigators reported that TLTG using the overlap method is safe and feasible [11-13].

Several reports investigated the short-term surgical outcomes of the TLTG using the overlap or functional method. Because of lack of comparative studies on this topic, whether the overlap or the functional method is a more optimal EJ reconstruction method in TLTG remains unclear. This study aimed to compare TLTG using the overlap method and the functional method and to identify the optimal method of intracorporeal esophagojejunal anastomosis in TLTG.

MATERIALS AND METHODS

1. *Patients*

We retrospectively reviewed data of 490 patients who underwent TLTG using either the overlap or the functional method for upper body gastric cancer between January 2011 and May 2018 at Asan Medical Center by an experienced single surgeon. The patients were selected based on the preoperative stage under clinical T3N3 staging in accordance with American Joint Committee on Cancer (AJCC) - International Union for Cancer Control (UICC) 7th edition [14]. All patients underwent D2 lymph node dissection in compliance with the gastric cancer treatment guidelines [15]. Preoperative examinations including esophagogastroduodenoscopy, endoscopic ultrasound, and computed tomography were performed on selected patients for tumor staging. Based on the operative findings, patients with serosa exposure were converted to open surgery, and therefore, were excluded from this study. Of the 490 patients, 365 underwent TLTG using the functional method and 125 underwent TLTG using the overlap method. The study was approved by the Institutional Review Board of Asan Medical Center (2018-1005).

2. *Surgical techniques*

We adopted the surgical procedures of Kim et al[7,16,21,23,24]. for the laparoscopy, posture of patients, gastrectomy, and lymph node dissection. We performed intracorporeal esophagojejunal anastomosis using the functional [7,16,21,23,24] or the overlap method [13] as follows:

In the functional method, approximately two-thirds of the esophagus diameter was transected 2 cm above the gastroesophageal junction, using an endoscopic linear stapler. The unstapled esophageal stump was then transected with laparoscopic scissors after the remnant stomach was grasped with a laparoscopic intestinal clamp to prevent cancer cell spillage. The specimen was subsequently removed through the umbilical port site by extending the incision. After the specimen was removed, the jejunum was then transected 30 cm below the ligament of Treitz, using an endoscopic linear stapler, and an efferent loop was turned counterclockwise to reconstruct the EJ.

An enterostomy at the end of the jejunum was made on the anti-mesenteric side of the Roux-en-Y lim, using ultrasonic scalpel, and an endoscopic linear stapler; Endoscopic linear staper was inserted into the esophagostomy and enterostomy of the jejunum to form an esophagojejunal anastomosis.

In the overlap method, the esophagus was rotated 90° counterclockwise and then transected by two-thirds of the esophageal diameter, allowing esophagostomy to be made on the posterior side of the esophagus. Using a endoscopic linear stapler, the jejunum was transected at a point 30 cm distal to the ligament of Treitz. A small enterotomy was made on the anti-mesenteric side of the efferent jejunum at 5–6 cm from the end of the jejunum. A limb of a 45-mm endoscopic linear stapler was inserted into the efferent loop and was drawn up to the esophagus. The other limb of the endoscopic linear stapler was introduced to the left side of the esophagus to construct a Roux-en-Y side-to-side esophagojejunal anastomosis.

In both methods, after EJ reconstruction, the entry hole was closed with three sutures for tissue approximation and fully closed using an endoscopic linear stapler. A jejunojejunal side-to-side anastomosis was made approximately 40–50 cm below the EJ. Finally, we performed sutures between the mesentery of the jejunum to prevent internal herniation.

3. *Clinical evaluation of surgical outcomes*

Data were collected to clinically evaluate surgical outcomes. Data regarding age, sex, body mass index (BMI), American Society of Anesthesiologist (ASA) score, presence of comorbidity, number of comorbidities, history of abdominal surgery, operative time, time to first flatus, intra- and post-operative transfusion, post-operative hospital stay, tumor size, number of retrieved lymph nodes, resection margins, and cancer stage based on the AJCC/UICC 7th edition[14], pick of pain score using the visual analog scale (VSA), and number of analgesics administered were collected. Post-operative pain control consisted of intravenous, patient-controlled analgesia (fentanyl 1500 to 3000 μg or oxycodone 100 to 200 mg) and intermittent analgesic infusions. The severity of post-operative pain was assessed using VSA and the

number of additional doses of analgesics required during hospital stay. In addition, information regarding combined major surgeries such as pancreatic, bile duct, colorectal cancer surgery; hysterectomy; salpingo-oophorectomy; adrenalectomy; and surgery of a hepatic cyst and combined minor surgeries such as appendectomy cholecystectomy, splenectomy were also collected. Post-operative complication was defined as any event requiring conservative or surgical treatment postoperatively. Early complications were defined as events occurring within 30 days and late complications as those occurring 30 days postoperatively. These complications were reviewed and classified based on the Clavien–Dindo classification system (CDC) [17].

4. *Statistical analysis*

Data were analyzed using the SPSS version 18.0 (SPSS Inc., Chicago, IL, USA). The Chi-squared test or Fisher exact test for categorical variables and the t-test or Mann–Whitney U test for continuous variables were used to compare the two groups. To reduce the impact of treatment-selection bias and potential confounding in an observational study, we also performed propensity score matching (PSM). The propensity scores were estimated with gastrectomy type as the dependent variable by multiple logistic regression analysis. A full non-parsimonious model was developed, which included age, sex, body mass index, American Society of Anesthesiologist score, presence of comorbidity, number of comorbidity, clinical T stage, clinical nodal stage, clinical tumor stage, history of abdominal surgery, and combined surgery. We used a 1:1 ratio for Greedy matching using a caliper of 0.2 standard deviations of the logit of the estimated propensity score without replacement. The absolute standardized differences were used to diagnose balance after PSM. All absolute standardized differences after matching were <0.1. In a propensity score-matched cohort, McNemar or marginal homogeneity test for categorical variables and paired t-test or Wilcoxon signed rank test for continuous variables were used to compare the two groups. Moreover, the risks of binary outcomes were estimated using logistic regression with generalized estimating equations (GEE) that accounted for the clustering of matched pairs [18]. A *P*-value <0.05 was considered statistically significant.

RESULTS

1. *Patient characteristics*

The clinical characteristics of the functional and overlap method groups are shown in Table 1. As demonstrated, age, clinical T stage, clinical TNM stage, and combined surgery were statistically significant between the functional and overlap method groups before PSM analysis (all $P<0.05$). However, such differences between the functional and overlap method groups dissolved for the PSM set. All baseline variables included in the model were well balanced variables within the standardized difference <0.1.

2. *Early surgical outcomes and pathologic results after PSM*

Table 2 presents details of the early surgical outcomes and postoperative pathologic results of patients who underwent the functional and overlap methods. The mean numbers of retrieved lymph nodes were 41.20±16.17 and 35.27±14.77 in the functional and overlap method groups, respectively, with a significant difference between the groups ($P=0.003$). Other pathological characteristics such as tumor size, resection margin, and pathologic TNM stage were not significantly different between the two groups. The patients who underwent the overlap method had significantly less pain score (6.97±2.09 vs 6.21±1.83 days; $P=0.003$) than their counterparts who underwent the functional method. Patients who underwent the overlap method stayed for fewer days in the hospital postoperatively than their counterparts who underwent the functional method, with no significant difference (10.57±12.00 vs 7.39±3.94 days; $P=0.080$). The two groups were not statistically different in terms of other early surgical outcomes.

3. *Postoperative complications after PSM*

Early and late post-operative complications are presented in Table 3. As shown in the table 3, no significant differences in early postoperative overall complications were noted between the two groups ($P=0.123$). However, significantly fewer individuals from the overlap method group demonstrated late complications than their counterparts from the functional method group ($P<0.05$). 15 patients (12.30%) from

the functional method group showed late complications, whereas only four patients (3.28%) did from the overlap method group (P=0.012). Furthermore, patients who underwent the overlap method showed significantly lower CDC scores compared with those who underwent the functional method (P<0.05).

4. EJ-related complications after PSM

EJ-related complications are presented in Table 4. The results displayed significant differences in late and total EJ-related complications between the two groups (P<0.05). As an illustration, late EJ-related complications were observed among four patients (3.28%) from the functional method group, whereas no cases were reported from the overlap method group (P=0.046). Also, eight cases (6.56%) of total EJ-related complications in the functional method group were observed, whereas one case (0.82%) of EJ-related complication was found in the overlap method group (P=0.020).

DISCUSSION

To our knowledge, this is the first study to compare the surgical outcomes between the overlap and functional methods of EJ in TLTG, using PSM analysis. The results of this study suggest that the overlap method demonstrates statistically significantly lower EJ-related complications than the functional method; thus, the overlap method could be a feasible and safe method for TLTG.

TLTG is not inferior to either laparoscopic-assisted total gastrectomy using extracorporeal EJ or open total gastrectomy. It not only yields a wider visual field, but also leads to shorter operative time, time to first flatus, commencement of soft diet, and postoperative hospital stay [19-24]. Intracorporeal EJ is increasingly performed in institutions because of the technical development of laparoscopic instruments and the accumulation of experience among surgeons. In TLTG, intracorporeal EJ has been performed in several ways. Typical methods that are widely used are trans-orally inserted anvil (orvil) using circular stapler, functional method, and overlap method using a linear stapler. The rates of EJ anastomotic complications such as EJ stenosis and leakage were higher with the use of orvil than with a linear stapler (leakage rate, 4.1% vs. 0.7%, $P>0.05$, stenosis rate 4.1% vs. 0%, $P<0.05$) [25]. Other study reported a higher incidence of EJ stenosis when the orvil device was used (8.8%) than with other procedures such as side-to-side anastomosis using a linear stapler (1.0%) or double-stapling technique using a circular stapler with a trans-abdominally inserted anvil (3.6%) [26]. Furthermore, because of transoral insertion, the risk of developing postoperative throat pain is higher or esophageal injury may occur. Therefore, TLTG using a linear stapler has been recently performed by replacing orvil.

Several studies have reported the safety and integrity of the functional method using a linear stapler. The overall postoperative and EJ-related complication rates are 10.1%–15.4% and 0%–4.6%, respectively [16, 27, 28]. Later, Inaba et al. introduced an alternative method to the functional method called the overlap method, which could reduce the tension in the EJ anastomosis site. According to a previous study, no complications were related to EJ, and overall rate of complications was 6% [12,13]. There

are studies reporting the results using either the functional or overlap method; however, no study has compared the results of these two methods simultaneously yet. Therefore, selecting the safer and more feasible for TLTG is difficult.

Our results using PSM analysis showed significantly lower total EJ-related complications, only one case of EJ leakage and no case of EJ stricture with the overlap method. In contrast, 6 patients had EJ stricture and 2 patients had EJ leakage with the functional method. There are several possible explanations why the overlap method demonstrated favorable outcomes compared with the functional method. First, in the overlap method, the direction of the roux limb enables easier passage of food. Specifically, the roux limb is less affected by the crus muscle because of its downward direction when performing EJ anastomosis. Thus, patients with short esophageal stump or narrow space around the EJ anastomosis are likely to benefit more from the overlap method than from the functional method. Second, the overlap method could decrease incidents of EJ leakage by reducing extensive mobilization of the roux limb and the tension of anastomosis. Therefore, obese patients with a large abdominal cavity or those with a short mesentery of the small bowel could expect better surgical results using the overlap method because it reduces the tension of anastomosis more than the functional method. Third, the overlap method is likely to reduce torsion of the jejunal limb compared to the functional method. Finally, the overlap method utilizes a triple linear stapler that enables a large anastomosis caliber and enhances the security of the anastomosis.

Based on our results, of the 9 patients with complications, 8 had CDC 3 complications, whereas the remaining patient fully recovered via conservative care such as antibiotics, fasting, and TPN. Of the 8 patients with CDC 3, 6 required interventions such as endoscopic ballooning, stent insertion, pigtail drainage, and two required surgeries (Table 5). No postoperative mortality occurred. As demonstrated, EJ-related complications are severe complications that require intervention or reoperation, increasing the postoperative hospital day and morbidity. Other studies also show that EJ-related complications are associated with high morbidity, high mortality, and fatal

prognosis [5, 29]. Thus, selecting a safe and appropriate EJ method is important because EJ-related complications in TLTG have an adverse effect on postoperatively recovery. The results of this study allow surgeons to select the optimal method for intracorporeal EJ.

According to early surgical outcomes, the retrieved LN (35.27±14.77) in the overlap method was statistically significantly smaller than that in the functional method (41.20±16.17). The recent AJCC cancer staging eighth edition suggests that at least 16 regionl node be assessed pathologically [30]. However, the reason for differences between the two groups is still unknown. In the overlap method, pain score was significantly lower, which is likely to be associated with lower complication rates.

The present study has several limitations. First, it is a retrospective study a single institution. Second, the PSM analysis was used to reduce the differences in the baseline characteristics, patient selection bias still exists. Third, the functional and overlap methods were implemented in different time periods. This may have influenced the proficiency level of the surgeon's laparoscope technique, differences in surgical instruments, and surgical outcomes. Finally, because the survival and recurrence rates were not considered, longer-term oncologic outcome analysis between these two methods is required.

CONCLUSION

In conclusion, because EJ-related complications were fewer in the overlap method, this study established that the overlap method should be considered safer and more feasible than the functional method in TLTG.

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Figure Legends

Figure 1. Functional method of totally laparoscopic total gastrectomy

(A) Nearly two-thirds of the esophageal diameter is transected from a sufficient proximal resection margin above the gastroesophageal junction by using an endoscopic linear stapler. (B) The unstapled esophagus is transected with laparoscopic scissors. (C) Enterostomy is made at the end of the jejunum. (D) An endoscopic linear stapler is inserted between the esophagostomy and enterostomy at the end of the jejunum. (E) After constructing an EJ, the entry hole is held with three sutures for tissue approximation. Subsequently, the entry hole is closed using an endoscopic linear stapler. (F) EJ after completion of the reconstruction.

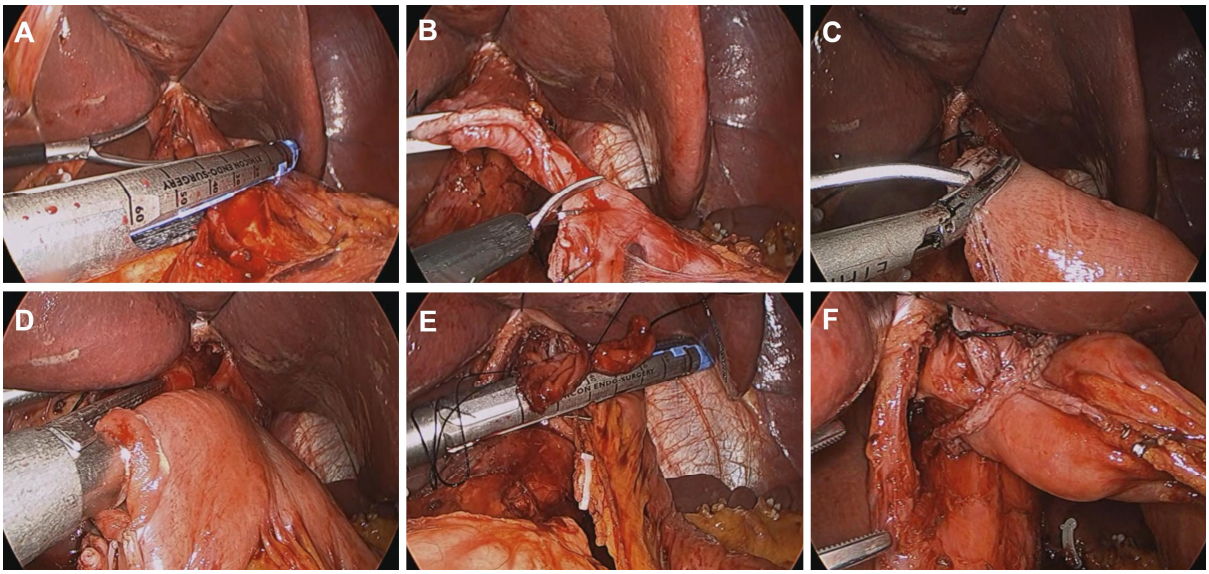

Figure 2. The overlap method of totally laparoscopic total gastrectomy

(A) The axis of the esophagus is rotated 90° counterclockwise, and nearly two-thirds of the esophageal diameter is transected, as in the functional method. (B) The unstapled esophagus is transected with laparoscopic scissors. (C) Enterostomy is made at 5–6 cm from the end of the jejunum. (D) An endoscopic linear stapler is inserted between the esophagostomy and enterostomy at 5–6 cm from the end of the jejunum. (E) After constructing an EJ, the entry hole is held with three sutures for tissue approximation. Subsequently, the entry hole is closed using an endoscopic linear stapler as in the functional method. (F) EJ after completion of the reconstruction.

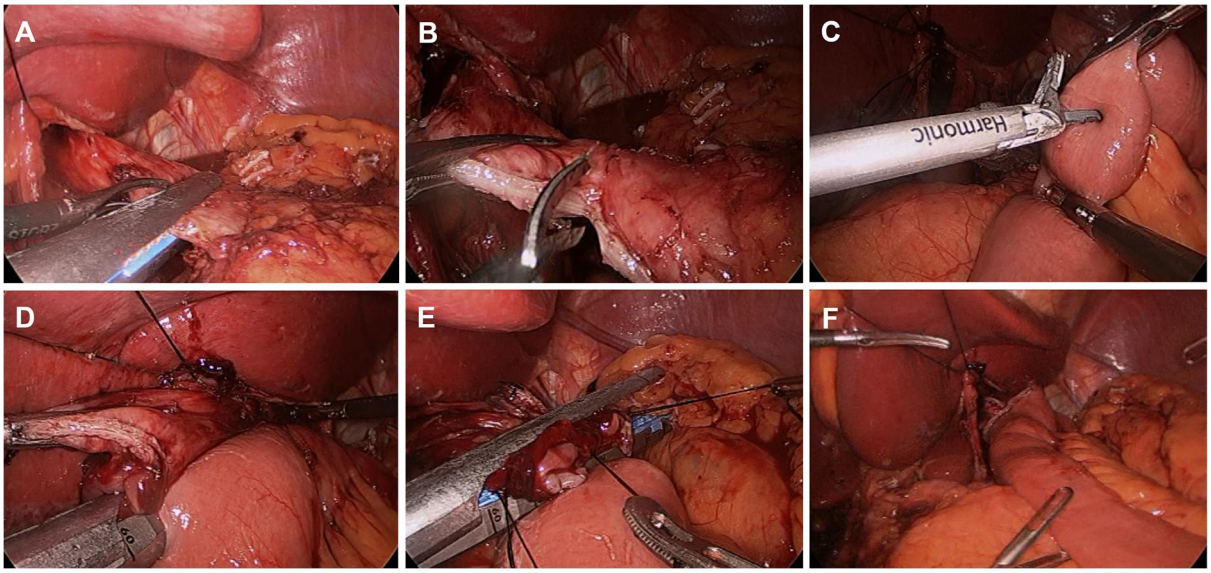

Figure 3. Complication cases of esophagojejunostomy: leakage and stricture

(A and B) UGI series and esophagogastroduodenoscopy in cases of EJ leakage. (A) shows that the contrast leaked into the intrathoracic cavity at the anastomosis site. (B) A Jackson–Pratt drain is observed through the EJ fistula within the abdominal cavity. (C and D) UGI series and esophagogastroduodenoscopy of the EJ stricture. (C) shows passage disturbance of contrast and marked afferent loop dilatation due to the EJ stricture. (D) the scope could not pass the EJ anastomosis site due to the EJ stricture.

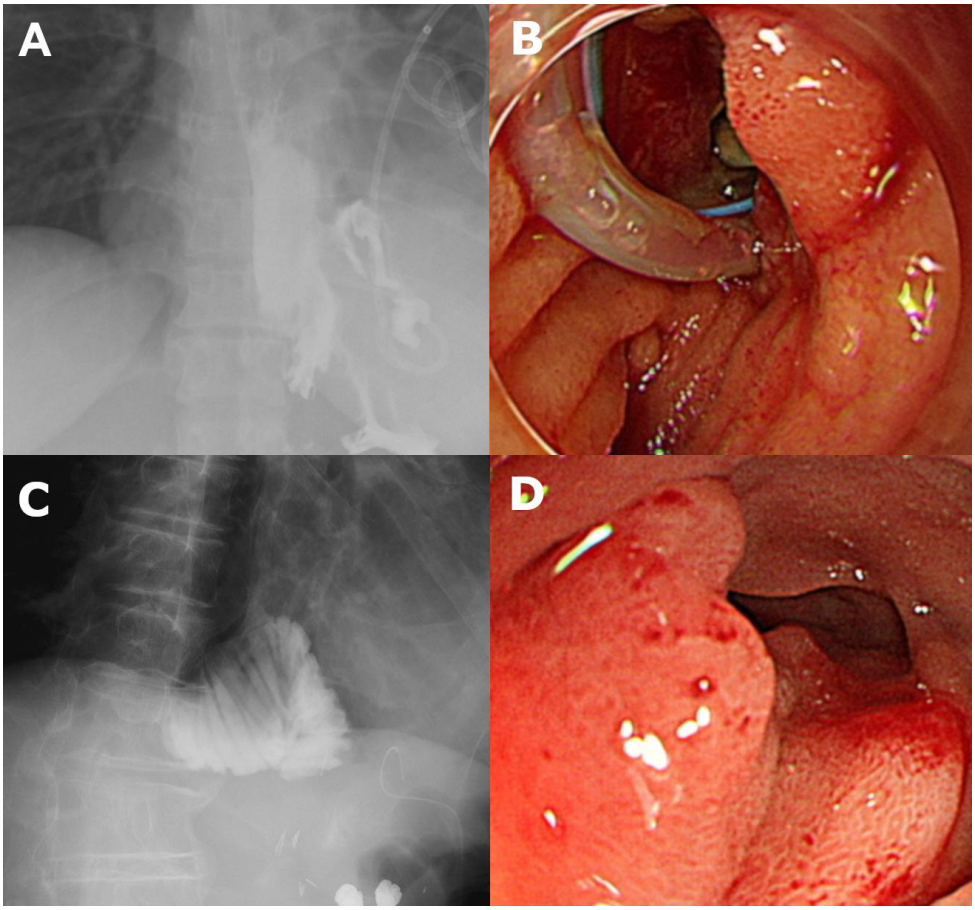

Table 1. Clinical characteristics of patients who underwent the functional and overlap methods

Variable	Total set (n=490)		*p* value	Stddiff	PSM set (1:1) (n=244)		Stddiff
	Functional method (n=365)	Overlap method (n=125)			Functional method (n=122)	Overlap method (n=122)	
Age (years, mean±SD)	58.48±11.00	61.60±12.72	0.015	0.245	61.30±10.87	61.25±12.68	0.003
Sex			0.498	0.072			0.053
Male	239 (65.48)	86 (68.80)			86 (70.49)	83 (68.03)	
Female	126 (34.52)	39 (31.20)			36 (29.51)	39 (31.97)	
BMI (kg/m²)	23.97±3.02	24.45±3.12	0.132	0.153	24.15±3.01	24.40±3.08	0.082
ASA score			0.455	0.130			0.050
I	223 (61.1)	71 (56.80)			70 (57.38)	71 (58.20)	
II	122 (33.42)	49 (39.20)			48 (39.34)	48 (39.34)	
III	20 (5.48)	5 (4.00)			4 (3.28)	3 (2.46)	
Number of comorbidities (number, mean±SD)	0.59±0.83	0.68±0.94	0.414	0.100	0.61±0.82	0.61±0.83	0.009

Presence of comorbidity				0.070			0.017
No	220 (60.27)	71 (56.8)			70 (57.38)	71 (58.20)	
Yes	145 (39.73)	54 (43.2)			52 (42.62)	51 (41.80)	
Clinical T stage			0.004	0.320			0.060
cT1	299 (81.92)	88 (70.40)			86 (70.49)	86 (70.49)	
cT2	42 (11.51)	17 (13.60)			19 (15.57)	17 (13.93)	
cT3	24 (6.58)	20 (16.00)			17 (13.93)	19 (15.57)	
Clinical nodal stage			0.364	0.089			0.082
Negative	305 (83.56)	100 (80.00)			94 (77.05)	98 (80.33)	
Positive	60 (16.44)	25 (20.00)			28 (22.95)	24 (19.67)	
Clinical tumor stage			0.043	0.248			0.060
I	315 (86.30)	96 (76.80)			92 (75.41)	94 (77.05)	
II	34 (9.32)	19 (15.20)			19 (15.57)	19 (15.57)	
III	16 (4.38)	10 (8.00)			11 (9.02)	9 (7.38)	
History of abdominal surgery			0.820	0.065			0.025
None	287 (78.63)	95 (76.00)			96 (78.69)	95 (77.87)	
Minor surgery	43 (11.78)	17 (13.60)			15 (12.30)	16 (13.11)	

Major surgery	35 (9.59)	13 (10.40)			11 (9.02)	11 (9.02)	
Combined surgery			0.001	0.352			0.045
None	337 (92.33)	101 (80.80)			99 (81.15)	101 (82.79)	
Minor surgery	22 (6.03)	21 (16.80)			20 (16.39)	18 (14.75)	
Major surgery	6 (1.64)	3 (2.40)			3 (2.46)	3 (2.46)	

Values are expressed as mean±SD or n (%).

PSM, Propensity score matching; Stddiff, Standardized difference; BMI, Body mass index; ASA, American Society of Anesthesiologists Physical Status Classification

Table 2. Early surgical outcomes and pathologic results in patients undergoing the functional and overlap methods

Variable	Total set (n=490)		*p* value	PSM set (1:1) (n=244)		*p* value
	Functional method (n=365)	Overlap method (n=125)		Functional method (n=122)	Overlap method (n=122)	
Operative time (min)	156.33±43.57	172.20±44.13	<0.001	160.31±46.47	170.76±42.23	0.075
Time to first flatus (days)	3.34±0.76	3.42±0.91	0.343	3.38±0.88	3.42±0.91	0.569
Transfusion during surgery (n)			0.446			0.317
No	364 (99.73)	124 (99.2)		121 (99.18)	122 (100.00)	
Yes	1 (0.27)	1 (0.80)		1 (0.82)	0 (0.00)	
Transfusion after surgery (n)			0.131			0.059
No	332 (90.96)	119 (95.20)		108 (88.52)	116 (95.08)	
Yes	33 (9.04)	6 (4.80)		14 (11.48)	6 (4.92)	
Pick of pain score	6.73±2.06	6.25±1.84	0.017	6.97±2.09	6.21±1.83	0.003
Administration of analgesics (n)	4.31±6.15	3.62±4.85	0.561	4.70±5.58	3.65±4.89	0.053

Hospital day after surgery (days)	10.50±12.88	7.52±4.10	0.003	10.57±12.00	7.39±3.94	0.080
Tumor size (cm)	3.73±2.56	4.58±3.45	0.004	3.86±2.57	4.62±3.47	0.065
Retrived LN	38.48±15.52	35.32±14.60	0.047	41.20±16.17	35.27±14.77	0.003
PRM (cm)	2.20±2.27	2.26±3.25	0.088	2.25±2.36	2.29±3.28	0.561
DRM (cm)	12.79±4.85	12.30±4.25	0.425	13.07±5.06	12.17±4.21	0.139
T stage			0.002			0.309
T1	252 (69.04)	63 (50.40)		74 (60.66)	61 (50.00)	
T2	60 (16.44)	26 (20.80)		24 (19.67)	26 (21.31)	
T3	32 (8.77)	23 (18.40)		16 (13.11)	22 (18.03)	
T4	21 (5.75)	13 (10.40)		8 (6.56)	13 (10.66)	
N stage			0.085			0.359
N0	304 (83.29)	91 (72.80)		92 (75.41)	89 (72.95)	
N1	29 (7.95)	17 (13.60)		10 (8.20)	17 (13.93)	
N2	19 (5.21)	10 (8.00)		14 (11.48)	9 (7.38)	
N3	13 (3.56)	7 (5.60)		6 (4.92)	7 (5.74)	
TNM stage			0.004			0.383

I	290 (79.45)	81 (64.80)	87 (71.31)	79 (64.75)
II	47 (12.88)	25 (20.00)	21 (17.21)	25 (20.49)
III	27 (7.40)	19 (15.20)	13 (10.66)	18 (14.75)
IV	1 (0.27)	0 (0.00)	1 (0.82)	0 (0.00)

Values are expressed as mean±SD or number (%) or median (range).

PSM, Propensity score matching; LN, Lymph node; PRM, Proximal resection margin; DRM, Distal resection margin

Table 3. Postoperative Complications

Variable	Total Set (n=490)		*p* value	PS matched set (1:1) (n=244)		*p* value
	Functional method (n=365)	Overlap method (n=125)		Functional method (n=122)	Overlap method (n=122)	
Early complications						
Overall complications			0.078			0.123
No	266 (72.88)	101 (80.8)		90 (73.77)	100 (81.97)	
Yes	99 (27.12)	24 (19.2)		32 (26.23)	22 (18.03)	
Clavien–Dindo classification			0.320			0.049
0	266 (72.88)	101 (80.8)		90 (73.77)	100 (81.97)	
1	9 (2.47)	2 (1.60)		3 (2.46)	2 (1.64)	
2	59 (16.16)	18 (14.40)		16 (13.11)	17 (13.93)	
3	29 (7.95)	4 (3.20)		12 (9.84)	3 (2.46)	
4	2 (0.55)	0 (0.00)		1 (0.82)	0 (0.00)	
Late complications						

Overall complications			<0.001			0.012
No	308 (84.38)	121 (96.80)		107 (87.70)	118 (96.72)	
Yes	57 (15.62)	4 (3.20)		15 (12.30)	4 (3.28)	
Clavien–Dindo Classification			0.001			0.004
0	308 (84.38)	121 (96.80)		107 (87.70)	118 (96.72)	
1	6 (1.64)	0 (0.00)		2 (1.64)	0 (0.00)	
2	12 (3.29)	0 (0.00)		2 (1.64)	0 (0.00)	
3	35 (9.59)	2 (1.60)		11 (9.02)	2 (1.64)	
4	3 (0.82)	2 (1.60)		0 (0.00)	2 (1.64)	
5	1 (0.27)	0 (0.00)		0 (0.00)	0 (0.00)	

Values are expressed as mean±SD or number (%).

Table 4. Esophagojejunostomy related complications

Variable	Total Set (n=490)		*p* value	PS matched set (1:1) (n=244)		*p* value
	Functional method (n=365)	Overlap method (n=125)		Functional method (n=122)	Overlap method (n=122)	
EJ-related complications (early)			0.056			0.180
No	347 (95.07)	124 (99.20)		118 (96.72)	121 (99.18)	
Yes	18 (4.93)	1 (0.80)		4 (3.28)	1 (0.82)	
EJ-related complications (late)			0.199			0.046
No	358 (97.53)	125 (100.00)		118 (96.72)	122 (100.00)	
Yes	7 (1.92)	0 (0.00)		4 (3.28)	0 (0.00)	
EJ-related complications (total*)			0.009			0.020
No	340 (93.15)	124 (99.20)		114 (93.44)	121 (99.18)	
Yes	25 (6.85)	1 (0.80)		8 (6.56)	1 (0.82)	
Leakage	14 (3.84)	1 (0.80)		3 (2.46)	1 (0.82)	
Stricture	11 (3.01)	0 (0.00)		5 (4.10)	0 (0.00)	

Values are expressed as mean±SD or number (%).

*Total: Early and late EJ-related complications

Table 5. Characteristics of patients with EJ-related complications

Case	Sex	Age	Primary Operation	TNM Stage	Early or late	Type of complication	CDC	Treatment	Outcomes
1	M	71	Functional	IA	Early	Leakage	3A	Intervention	Full recovery
2	F	65	Functional	IIB	Late	Stricture	3A	Intervention	Full recovery
3	F	53	Functional	IIIC	Late	Stricture	3A	Intervention	Full recovery
4	F	54	Functional	IB	Early	Stricture	3A	Intervention	Full recovery
5	M	58	Functional	IB	Early	Leakage	3A	Intervention	Full recovery
6	M	62	Functional	IIA	Late	Stricture	3A	Intervention	Full recovery
7	M	54	Functional	IB	Early	Leakage	3B	Operation	Full recovery
8	M	59	Overlap	IA	Early	Leakage	2	Conservative	Full recovery
9	M	64	Functional	IB	Late	Stricture	3B	Operation	Full recovery

CDC: Clavien–Dindo classification

KOREAN ABSTRACTS

연구목적

전복강경하 위전절제 수술에서 식도 공장 문합 방법인 Overlap 술식과 Functional 술식에 대한 수술 후 임상경과를 고찰하여 보다 안전하고 효율적인 식도 공장 문합 방법을 입증하고자 하였다.

연구방법

2011 년 1 월부터 2018 년 5 월까지 서울아산병원에서 상부 위암으로 전복강경하 위전절제 수술을 받은 490 명의 환자들을 대상으로 분석하였다. 490 명 중 365 명은 Functional 술식으로 시행받은 환자들이었고 125 명은 Overlap 술식으로 시행받은 환자들이었다. 나이, 성별, 체질량 지수, American Society of Anesthesiologist 점수, 동반질환 유무, 동반질환의 개수, clinical T stage, clinical nodal stage, clinical TNM stage, 과거 복부 수술력, 동반 수술 여부를 비교하여 Propensity score matching 분석을 시행하였다. 1:1 Propensity score matching 이후 Functional 술식을 받은 122 명과 Overlap 술식을 받은 122 명 환자들을 식도 공장 문합 관련 합병증을 포함하여 수술 후 임상 경과를 분석하였다.

연구결과

수술 후 통증 점수는 Overlap 술식으로 시행 받은 환자들에게서 통계적으로 유의하게 낮은 결과를 보였다(functional 술식 [6.73±2.06] vs overlap 술식 [6.25±1.84], $P<0.05$). 하지만, 수술시간, 수술 후 처음 방구 배출까지 소요시간, 수술 후 입원기간, 수술 중 수혈, 수술 후 수혈, 진통제 투약 횟수 등 다른 수술 후 조기 임상 경과에는 통계적으로 유의한 차이는 보이지 않았다. 식도 공장 문합 관련 합병증으로 Overlap 술식을 시행 받은 환자들에게서 통계적으로 유의하게 더 낮은 합병증 비율을 보였으며(functional 술식 [n=8, 6.56%] vs overlap 술식 [n=1, 0.82%], $P<0.05$), 또한 더 낮은 후기 합병증 비율(overlap method [n=4, 3.28%] vs functional method [n=15, 12.30%]) 그리고 더 낮은 Clavien-Dindo classification 등급을 보였다.

결론

전복강경하 위전절제 수술에서 Overlap 술식이 Functional 술식에 비하여 식도 공장 문합 관련 합병증이 더 적게 나타났다. 따라서 Overlap 술식이 전복강경하 위전절제 수술에 있어 더 안전하고 유용한 식도 공장 문합 방법이라고 할 수 있겠다.