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Assessment of the Double-Staple Technique for Esophagoenteric Anastomosis in Gastric Cancer

Audrey H. Choi¹, Amanda Arrington², Ann Falor¹, Rebecca A. Nelson³, Michael Lew⁴, Joseph Chao⁵, Byrne Lee¹, and Joseph Kim⁶

Byrne Lee: bylee@coh.org; Joseph Kim: joekim7@yahoo.com

¹Department of Surgery, City of Hope National Medical Center, Duarte, CA, USA

²Department of Surgery, Marshall University Edwards Comprehensive Cancer Center, Huntington, WV, USA

³Departments of Biostatistics, City of Hope National Medical Center, Duarte, CA, USA

⁴Departments of Anesthesia, City of Hope National Medical Center, Duarte, CA, USA

⁵Departments of Medical Oncology, City of Hope National Medical Center, Duarte, CA, USA

⁶Division of Surgical Oncology, Department of Surgery, SUNY Stony Brook, New York, NY, USA

Abstract

Introduction—Reports on outcomes after double-staple technique (DST) for total and proximal gastrectomy are limited, originating mostly from Asian centers. Our objective was to examine anastomotic leak and stricture with DST for esophagoenteric anastomosis in gastric cancer patients.

Methods—A single institution review was performed for patients who underwent total/proximal gastrectomy with DST between 2006 and 2015. DST was performed using transoral anvil delivery (OrVil™) with end-to-end anastomosis. Clinical characteristics and outcomes, including anastomotic leak and stricture, were recorded.

Results—Overall, DST was performed in 60 patients [total gastrectomy (81.7 %, $n = 49/60$), proximal gastrectomy (10.0 %, $n = 6/60$), and completion gastrectomy (8.3 %, $n = 5/60$)]. Neoadjuvant chemotherapy was administered to 21 patients (35.0 %), and 6 patients (10.0 %) received external beam radiation therapy prior to completion gastrectomy. Operative approach was open (51.7 %, $n = 31/60$), laparoscopic (43.3 %, $n = 26/60$), or robotic (5.0 %, $n = 3/60$). Anastomotic leak occurred in 6.7 % ($n = 4/60$), while stricture independent of leak was identified in 19.0 % ($n = 11/58$) of patients. Complications occurred in 38.3 % ($n = 23/60$) of patients, of which 52 % were classified as Clavien-Dindo grades III–V complications.

Correspondence to: Byrne Lee, bylee@coh.org; Joseph Kim, joekim7@yahoo.com.

Byrne Lee and Joseph Kim are co-senior authors.

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Conflict of Interest The authors declare that they have no competing interests.

Conclusion—In the largest Western series of DST for esophagoenteric anastomoses in gastric cancer surgery, our experience demonstrates that DST is safe and effective with low rates of leak and stricture.

Keywords

Double-staple technique; Total gastrectomy; Proximal gastrectomy; Gastric cancer

Introduction

Adoption of totally laparoscopic gastrectomy has not been rapid, in part, due to the technical challenges of creating the esophagojejunal anastomosis. With the traditional open approach, a hand-sewn esophagoenteric anastomosis may be created using running or interrupted sutures. An end-to-end anastomosis (EEA) between the esophagus and jejunum can also be created in the open approach using an EEA stapler, which requires the placement of an anvil in the distal esophagus. Typically, the anvil is secured into position with a pursestring suture at the open end of the esophagus. Either anastomotic technique (hand-sewn or stapled) can be challenging in a minimally invasive approach. Although many solutions have been proposed to manage the technical challenges,^{1–7} there is no universally accepted method to create the esophagoenteric anastomosis with laparoscopic or robotic gastrectomy. The double-staple technique (DST), which can be used in either open or totally laparoscopic approaches, facilitates the creation of the esophagoenteric anastomosis by precluding the need for suture anastomosis or creation of a purse-string.

A transoral anvil delivery system (Orvil™) has been developed which facilitates the creation of a stapled anastomosis without the need for a purse-string to secure the anvil into position. Since our surgical philosophy has been to employ similar techniques for both open and minimally invasive procedures, we have used DST with the Orvil™ for all gastric resections needing esophagoenteric anastomosis. Series describing perioperative outcomes after the use of DST for gastric cancer are limited and little is known in Western patient populations whether the Orvil™ is safe for creation of esophagoenteric anastomosis. The objective of this study was to present our institutional experience with this technique. This is the largest reported Western series of both open and minimally invasive DST cases for gastric cancer.

Methods

Patient Selection

With approval of the Institutional Review Board, patients undergoing proximal, completion, and total gastrectomy for gastric cancer were identified from the City of Hope Cancer Registry between 2006 and 2015. Operative reports were reviewed to verify that patients underwent esophagoenteric anastomoses using DST. Patient and treatment-related variables were tabulated, including comorbid conditions, operative approach, and receipt of neoadjuvant therapies.

Port Placement for Minimally Invasive Total Gastrectomy

Port placement varies slightly between the laparoscopic and robotic approaches.⁸ For the laparoscopic approach, a 10/12-mm port is placed at the midline near the umbilicus. This port is used interchangeably for the camera or grasping/dissecting instruments. Two additional 10/12-mm ports are placed on the patient's left side at least one hands breadth apart. Two 5-mm ports are placed on the right side, mirroring the position of the left-sided ports. The linear stapler is passed through any one of the three 10/12-mm ports. The left medial 10-/12-mm port is enlarged to accommodate the EEA stapler and the specimen for extraction (Fig. 1).

Operative Technique

For DST, transoral delivery (Orvil™, Covidien) (Fig. 2) of an anvil attached to an orogastric tube was passed down the esophagus by the anesthesiologist or a surgical assistant (Fig. 3).⁸ Following transection of the esophagus with a linear stapler, the Orvil™ was advanced down the esophagus and into the abdominal cavity through an esophagotomy created adjacent to the staple line. The anvil was detached from the orogastric tube once the connecting string was cut. The orogastric tube was removed, and the anvil was interfaced with an EEA stapler to create the second staple line (Fig. 4).⁸ With the exception of one patient whose anastomosis was created with a 21-mm EEA stapler, all anastomoses were performed with a 25-mm EEA stapler.

Classification of Complications

Anastomotic leaks and strictures were tabulated, as these are two well-known and potentially serious complications of a stapled anastomosis technique. Anastomotic leaks were defined as peri-anastomotic extravasation of oral contrast on radiographic imaging or visible signs of anastomotic disruption on endoscopy. Anastomotic strictures were defined as symptomatic narrowing at the anastomosis requiring dilation. Postoperative complications were classified according to the Clavien-Dindo grading system on a scale from I to V.⁹ All data are expressed as either median (range) or mean± standard deviation (SD).

Results

Patient and Operative Characteristics

From 2006 to 2015, 60 patients underwent esophagoenteric anastomosis with DST for gastric cancer. Demographic and clinical variables are listed in Table 1. AJCC staging was relatively evenly distributed between stages I and III. One patient had complete pathologic response following neoadjuvant therapy, and one patient underwent prophylactic gastrectomy for hereditary gastric cancer. In patients with AJCC stage IV disease, one patient underwent palliative gastrectomy, two patients had gastrectomy during surgical cytoreduction combined with heated intraperitoneal chemotherapy, and two patients had omental metastases diagnosed on final pathologic exam.

Of the 60 patients in the cohort, 35.0 % ($n=21$) of patients received neoadjuvant chemotherapy, while 10.0 % ($n=6$) of patients had previously received external beam radiation therapy. The majority of these radiation therapy patients ($n=5/6$) underwent

completion gastrectomy for recurrent gastric carcinoma and had been previously treated with adjuvant chemoradiation following their index operation. The remaining patients were treated with total gastrectomy ($n=49/60$) or proximal gastrectomy ($n=6/60$). The operative approach was laparotomy in 51.7 % ($n=31/60$) of patients, laparoscopic gastrectomy in 43.3% ($n=26/60$), and robotic gastrectomy in 5.0% ($n=3/60$).

Perioperative Outcomes After DST for Gastric Carcinoma

Anastomotic leak was detected in four patients (6.7 %) with a median time to diagnosis of 12 days (range 5–14 days, Table 2). Although these patients had a negative esophagogram or upper endoscopy 2–3 days postoperatively, all four patients were eventually diagnosed with anastomotic leak by computed tomography (CT). Patients were treated with CT-guided drainage and antibiotics ($n=1$), endoscopic stent placement ($n=2$), or operative repair ($n=1$). None of our patients were diagnosed or treated for intraabdominal abscess that may have been the result of an anastomotic leak. Anastomotic stricture independent of leak was detected in 11 of 58 patients (19.0 %) with a median time to diagnosis of 104 days (range 40–405 days, Table 2). The median number of endoscopic dilations required to achieve symptomatic relief was 1.5 (range 1–17). Two patients who experienced leak developed anastomotic stricture. These two patients required the greatest number of repeat dilations (5 and 17 dilations, respectively).

Twenty-three patients (38.3 %) experienced postoperative complications. The majority of the complications were grades II and III (Table 2). Apart from leak and stricture, other gastrointestinal complications included duodenal stump leak, pseudo-obstruction, and delayed gastric emptying. In addition to the patient requiring operative repair of anastomotic dehiscence, two other patients required reoperation for small bowel obstruction and intestinal volvulus around a jejunal feeding tube. There were two postoperative deaths in the series: one was due to septic shock and the second due to complications following major hemorrhage. The median follow-up time for the entire cohort was 457 days.

Discussion

Although laparoscopic distal gastrectomy may be routinely performed in both Asian and specialized Western centers, the adoption of minimally invasive techniques for total and proximal gastrectomy has been relatively slow. This condition is likely related to the technically challenging esophagoenteric reconstruction, which requires the use of advanced minimally invasive techniques. Even in Asia, where totally laparoscopic and laparoscopic-assisted total gastrectomy are performed in great numbers, there is no standard technique for the creation of the esophagoenteric anastomosis. Drawing upon our early experience with minimally invasive gastrectomy, we now utilize DST for all open and laparoscopic/robotic total gastrectomy procedures. It is our senior author's practice to utilize the same anastomotic method regardless of whether the gastrectomy is performed open or laparoscopic/robotic. This routine is based on our perspective that the surgeon should not offer different or suboptimal techniques in relation to a laparotomy vs. laparoscopy approach. Our approach with DST demonstrates that it can be easily adopted to provide safe and effective creation of the esophagoenteric anastomosis in any setting.

The quality of the esophagoenteric anastomosis can be judged in part by its corresponding complications. In our series, we examined anastomotic leak and stricture after DST for gastric cancer, which in the literature can occur in up to 17 %^{2,10–13} and 33 %^{2,5,7,10–12,14} of patients, respectively. In our study, the leak rate was 6.7 % and the stricture rate independent of leak was 19.0 %. We acknowledge that our series may underestimate the true leak rate, as subclinical leaks with negative postoperative swallow studies may have been difficult to diagnose. Nevertheless, none of our non-leak patients had abscess or peri-anastomotic fluid collections diagnosed on CT imaging suggestive of a leak. The overall complication rate (including non-anastomotic complications) was 38.3 %. It is feasible that pre-existing medical conditions may have predisposed our patients to having stricture, leak, or any other complication. We noted that 10 % of our patients received prior external beam radiation therapy, while over 30 % of our patients received neoadjuvant chemotherapy. When examining postoperative strictures, the majority of patients with stricture had symptoms that resolved with one to two endoscopic dilatations, and none of the patients with stricture underwent reoperation. Furthermore, as we have gained experience with DST, we have had zero leaks and only two strictures in the last 20 DST since 2013.

To our knowledge, we have the largest reported series on DST for gastric cancer from a Western population. Other smaller series have reported comparable results mostly with open procedures.¹² In our series, we performed a higher rate of procedures using a minimally invasive approach with 43.3 % performed laparoscopically and 5.0 % robotically. Our single institution series adds to a small body of literature collected on DST for esophagoenteric anastomosis for gastric cancer outside of Asian centers. We now use DST for all open and minimally invasive approaches knowing that our technique and approach can facilitate safe and effective esophagoenteric anastomosis that may be superior to other existing techniques. Surgeons considering this technique should familiarize and gain experience with the open technique and then proceed to laparoscopic or robotic technique.

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Fig. 1.

Port placement for minimally invasive total gastrectomy. A 10–/12-mm port is placed at the midline near the umbilicus, which is used interchangeably for the camera or grasping/ dissecting instruments. Two additional 10–/12-mmports are placed on the patient’s left side at least one hand breadth apart. Two 5-mm ports are placed on the right side, mirroring the position of the left-sided ports. The linear stapler is passed through any one of the three 10–/12-mmports. The left medial 10–/12-mm port is enlarged to accommodate the EEA stapler and the specimen for extraction. (Adapted from Hamner JB, Kim J (2014). Laparoscopic distal/subtotal gastrectomy. In Kim J and Garcia-Aguilar J (Eds), *Surgery for Cancers of the Gastrointestinal Tract*)

Fig. 2.
OrvilTM transoral anvil delivery device (courtesy of Covidien)

Fig. 3. Transoral insertion of the Orvil™. **a** The lubricated orogastric tube is advanced by the surgeon's assistant until the anvil passes through the oral cavity, **b** ensuring that the flattened head is facing the patient's hard palate (courtesy of Covidien)

Fig. 4.

Creation of the esophagoenteric anastomosis with DST. **a** Orogastric tube is pulled through the esophagotomy, **b** until the plastic collar of the anvil is visualized. **c** One suture of the anvil is cut to remove the orogastric tube. **d** The EEA stapler is then passed through the Roux limb and articulated with the anvil head that is seated adjacent to the esophageal stump staple line. After the circular stapler is fired, the remainder of the intestine is closed with a linear stapler (courtesy of Covidien)

Table 1

Patient and operative characteristics of patients undergoing double-staple technique for gastric adenocarcinoma

	<i>N</i> = 60 <i>N</i> (%)
Age (years) (range) ^a	64 (20–89)
Sex	
Male	37/60 (61.7 %)
Female	23/60 (38.3 %)
AJCC stage	
0	2/60 (3.3 %)
I	16/60 (26.7 %)
II	18/60 (30.0 %)
III	19/60 (31.7 %)
IV	5/60 (8.3 %)
Pathology	
Adenocarcinoma	55/60 (91.7 %)
Other	5/60 (8.3 %)
Preoperative albumin (g/dL) ^b	4.1 ± 0.4
Diabetes mellitus	12/60 (20.0 %)
Prior gastric or esophageal surgery	8/60 (13.3 %)
Neoadjuvant chemotherapy	21/60 (35.0 %)
Neoadjuvant radiation therapy	6/60 (10.0 %)
Surgical procedure	
Completion gastrectomy	5/60 (8.3 %)
Total gastrectomy	49/60 (81.7 %)
Proximal gastrectomy	6/60 (10.0 %)
Surgical approach	
Open	31/60 (51.7 %)
Laparoscopic	26/60 (43.3 %)
Robotic	3/60 (5.0 %)
Operative time (min) ^b	366 ± 111
EBL (ml) ^b	281 ± 234

EBL estimated blood loss

^aMedian (range)

^bMean ± SD

Table 2

Perioperative outcomes of patients who underwent double-staple technique for gastric adenocarcinoma

	<i>N</i> = 60 <i>N</i> (%)
Anastomotic leak	4/60 (6.7 %)
Median time to leak (days)	12 (5–14)
Anastomotic stricture	13/60 (21.7 %)
Median time to stricture (days)	104 (40–405)
Length of stay (days) ^a	9 (5–67)
Complications ^b	23/60 (38.3 %)
Grade I	2/60 (3.3 %)
Grade II	9/60 (15.0 %)
Grade III	10/60 (16.7 %)
Grade IV	0/60 (0 %)
Grade V	2/60 (3.3 %)

^aMedian (range)

^bClavien-Dindo classification