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HOW I DO IT

Laparoscopic Distal, Subtotal Gastrectomy for Advanced Gastric Cancer

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Abstract The objective of this study was to show laparoscopic subtotal, distal gastrectomy with D2 lymphadenectomy as a safe and appropriate method for the resection of advanced gastric cancer. This study was conducted at a designated NCI Cancer Center. Subjects of the study were patients with advanced gastric malignancy, including transmural penetration of the tumor and/or nodal disease, requiring subtotal, distal gastrectomy. The main outcome measure is a description of the technique of a laparoscopic subtotal, distal gastrectomy for antral and distal body tumors. In conclusion, the laparoscopic approach to advanced gastric malignancy with a subtotal, distal gastrectomy and D2 lymphadenectomy is a safe, oncologically appropriate procedure which provides excellent outcomes.

Keywords Laparoscopic gastrectomy · Advanced gastric cancer

Introduction

There has been significant debate over the use of laparoscopic resection for the management of advanced gastric cancer. Laparoscopic surgery appears as a favorable approach given the previously reported decrease in postoperative pain, pulmonary complications, and hospital lengths of stay.[1,2] The reluctance to widely adopt this technique is over the concern for the oncologic completeness of the laparoscopic approach and the complexity of the procedure. Splenic-preserving D2 lymphadenectomy should be performed for appropriate patients undergoing resection for advanced gastric cancer given the reported decreased locoregional recurrence rates and gastric cancer-related deaths.[3] We describe our preferred approach for a laparoscopic distal, subtotal gastrectomy with D2 lymphadenectomy and a Billroth II reconstruction for advanced T stage (T3) and/or node-positive disease.

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Methods

The standard workup for evaluation and staging of gastric cancer is utilized including endoscopic ultrasound (EUS) and CT scans.[4] Diagnostic laparoscopy and peritoneal washings should be considered for locoregionally advanced disease prior to the initiation of neoadjuvant therapy.[5] Neoadjuvant therapy is performed for T3–T4 and/or node-positive, M0 malignancy.[6] Following the completion of neoadjuvant therapy, patients are restaged with CT imaging. Surgery is offered to those patients who are medically fit and in whom no evidence of metastatic disease is identified. Laparoscopic subtotal, distal gastrectomy with Billroth II reconstruction is our standard approach for tumors of the antrum and distal body. Details of positioning and required equipment are described (Table 1).

Operative Description

Positioning

The patient is positioned supine on the operating room table. Standard anesthesia techniques are utilized. An 18-gauge

Table 1 Patient positioning and required equipment

Patient positioning	1. Arms can be tucked or out at sides.
	2. Patient is supine and a footboard is placed.
	3. Surgeon stands on the right, and assistant stands on the left side of the table.
	4. No need for lithotomy position.
Equipment	1. Nathanson retractor
	2. Long (45 cm) instruments
	3. Long bovie tip
	4. Endoscopic stapler with intermediate and thick tissue loads
	5. Staple reinforcement with peristrips
	6. Small wound protector
	7. 35-cm-long clip applier
	8. ENDOSTITCH with 2-0 silk and 2-0 vicryl sutures
	9. 5-mm optical view port (1), 5-mm ports (2), and 12-mm port (1)

nasogastric tube is placed to aid with decompression of the stomach. Arms may be tucked or left out at the sides. A foot board is placed and the patient is secured to allow for steep reverse Trendelenburg positioning. The operating surgeon stands on the right side of the table with the assistant on the contralateral side, avoiding the need for a split leg table (Table 1).

Laparoscopic Port Placement

A 5-mm ENDOPATH XCEL® with an OPTIVIEW® trocar is placed under direct vision using a 5-mm, 0° scope, 2 cm below the lateral left subcostal margin (Ethicon Endo-Surgery, Inc., Cincinnati, OH). After appropriate pneumoperitoneum is obtained with 15 mmHg insufflation, the scope is changed to a 5-mm, 30° scope attached to a high-definition camera head. A 5-mm port is placed in the supraumbilical area just left of the midline. A 12-mm port is placed on the contralateral side at least 10 cm from the periumbilical port. A third 5-mm port is placed in the right subcostal margin, again at least 10 cm above the previously placed trocar. The abdomen is thoroughly inspected for evidence of metastatic disease. Following this, the patient is placed in steep Trendelenburg position, and a 5-mm incision is created inferior and left of the xiphoid process to allow for a Nathanson liver retractor to be placed and secured to a fixed arm on the right side of the table (Fig. 1a, b).

The abdominal dissection can be divided into eight steps:

1. Dissection of the omentum. The omentum is dissected away from the transverse colon. This is completed with an ENSEAL® tissue-sealing device (Ethicon Endo-Surgery, Inc., Cincinnati, OH). Care is taken not to enter the lesser sac. The omental bursa is excised in its entirety including the anterior leaf of the transverse colon mesentery. This dissection continues laterally to the left to the level of the inferior border of the spleen. The left gastroepiploic artery is divided in this location. The proper plane for omental bursal excision is best entered by the assistant standing on the left side of the table and dissecting the anterior leaf from the right transverse colon mesentery. The dissection is then continued at the mid transverse colon by the surgeon from the right side of the table and extended towards the spleen. The dissection of the anterior leaf of the transverse mesocolon is continued to include stripping of the capsule of the pancreatic neck and body using a combination of blunt and sharp dissection.
2. Division of right gastroepiploic vessels. The posterior wall of the stomach is grasped and elevated to allow

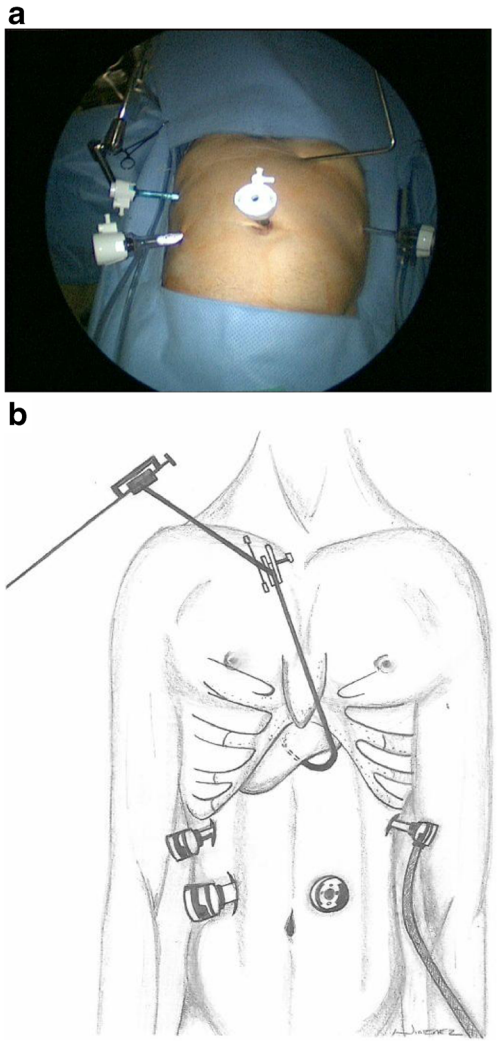

Fig. 1 **a** Picture of port placement with a Nathanson liver retractor in place. **b** Line drawing of operative port and retractor placement. Typically, a single 12-mm port is utilized on the right abdomen together with a 5-mm port. A 5-mm camera port is placed in the midline. A 5-mm port is placed in the left subcostal location, and the Nathanson retractor is placed in the subxiphoid location

dissection of the vessels. The head of the pancreas is exposed. All of the gastropancreatic folds are divided, and the gastroduodenal artery (GDA) is visualized. The capsule of the pancreas is stripped as described above to allow dissection superior to the pancreas, directly on the common hepatic artery. The right gastroepiploic vessels are identified and isolated. This is best done by the surgeon standing on the right side of the table by making a window with a Maryland dissector around the vein and artery. The vessels are typically divided with an ECHELON FLEX™ ENDOPATH® 60-mm vascular load stapler (Ethicon Endo-Surgery, Inc., Cincinnati, OH) or between 10-mm surgical clips with a ligating device (Fig. 2).

3. Division of the right gastric artery. The artery is dissected superior to the pylorus. It is identified and isolated near its takeoff from the proper hepatic artery. Care is taken not to disrupt the flow of the proper hepatic artery. The ENSEAL® device is used for the division (Fig. 3).
4. Division of the duodenum. Ensure all omental tissue is separated from the inferior border of the first portion of the duodenum. The duodenum is elevated and isolated from the surrounding tissues. It is divided using an ECHELON FLEX™ ENDOPATH® 60-mm bowel stapler reinforced with PERI-STRIPS DRY® with VERITAS® (Synovis Surgical Innovation, Inc., Deerfield, IL) (Fig. 4).
5. D2 lymphadenectomy. The antrum of the stomach is retracted towards the patient's left. The gastrohepatic omentum is widely divided close to the liver. The dissection begins at the hepatic artery node. The assistant lifts the hepatic artery node, and the operating surgeon uses a curved tip dissector to perform the dissection (Fig. 5). Dissection continues along the superior border of the pancreas, elevating all intervening nodal tissue until the left gastric vein is encountered. The vein can be rapidly isolated by the assistant from the left side of the table. The vein can be divided using clip placement and ligated with the ENSEAL® device (Fig. 6). Next, the left gastric artery is identified and isolated (Fig. 7). Transection of the left gastric artery is completed in all cases because it allows for proper nodal dissection including the stripping of the lymphatic tissue just below the gastroesophageal junction down to the proposed line of transection. The left gastric artery is divided using an ECHELON FLEX™ ENDOPATH® 60-mm vascular load stapler. The dissection continues along the splenic artery, elevating the nodal tissue along the proximal splenic artery. The nodal tissue along the left and right crura is also elevated to reflect this tissue inferiorly along with the specimen. Included in the D2 lymphadenectomy are lymph node stations 5–9. In addition, stations 1 and 3a are stripped down towards the specimen until the proposed line of transection is reached.
6. Clearance of the paracardial nodes. Starting at the GE junction, the nodal tissue along the lesser curvature of the stomach is stripped down until just below the planned point of division of the stomach. Prior to gastric division, all the tissue is separated from the wall of the stomach.

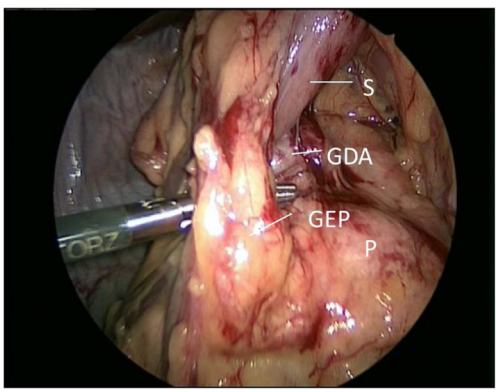

Fig. 2 Dissection of the right gastroepiploic vessels. *S* stomach, *GDA* gastroduodenal artery, *GEP* gastroepiploic pedicle, *P* pancreas. The right gastroepiploic vessels are stapled and divided utilizing the right-sided 12-mm port. Alternatively, these vessels can be divided with an ENSEAL® device

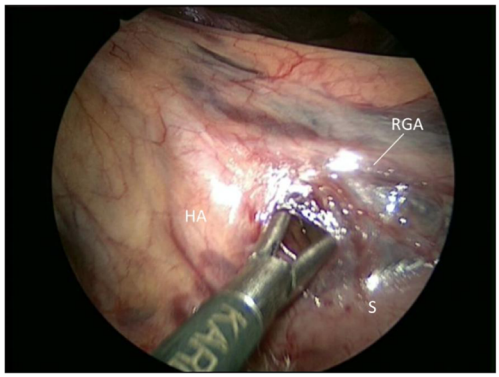

Fig. 3 Dissection of the right gastric artery (*RGA*) at the level of the pylorus. *S* stomach, *HA* hepatic artery. The RGA is divided utilizing the ENSEAL® device near its origin from the common hepatic artery

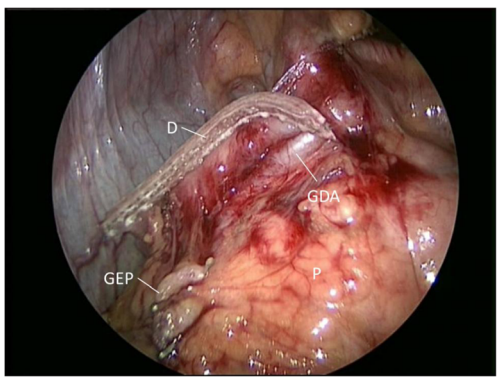

Fig. 4 Division of the duodenum (*D*). *GDA* gastroduodenal artery, *GEP* gastroepiploic pedicle, *P* pancreas. Note the staple line reinforcement on the duodenal stump

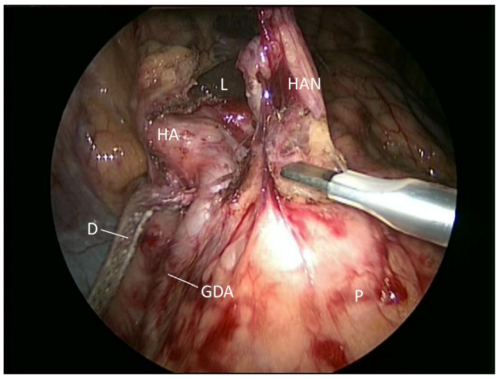

Fig. 5 D2 lymphadenectomy to encompass lymph node stations 5–9 is started by dissecting the hepatic artery node (*HAN*) off the proper hepatic artery (*HA*). The dissection continues from *right* to *left*. The dissection can be performed with a long bovie or with a curved ENSEAL® device. *D* duodenum, *L* liver, *GDA* gastroduodenal artery, *P* pancreas

This plane can be sometimes found more easily by the assistant standing on the left side of the table.

7. Endoscopy for tumor localization and marking. Intraoperative endoscopy is completed to mark the proposed line of transection on the stomach to ensure appropriate margins (at least 5 cm). The proposed line of transection is marked with a 2-0 silk ENDOSTITCH™ suture (Covidien, Norwalk, CT).
8. Division of the stomach. After removing the NG tube, the stomach is divided along the chosen transection line using an ECHELON FLEX™ ENDOPATH® 60-mm gastric stapler reinforced with PERI-STRIPS DRY® with VERITAS®. Generally, the stapling of the stomach is completed from the right side of the table. If there is difficulty completing this, the assistant's left-sided 5-mm port can be increased to a 12-mm port and the stapling can be completed from the left. A flexible reticulating stapler is essential for gastric transection.

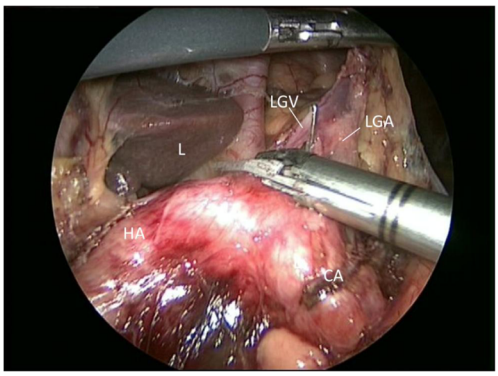

Fig. 6 Dissection taken to the left gastric vein (*LGV*) where it is then ligated. The left gastric vein is divided utilizing clips near its origin from the portal vein. The left gastric artery is stapled and divided near its origin from the celiac axis. *HA* common hepatic artery, *L* liver, *LGA* left gastric artery, *CA* celiac axis

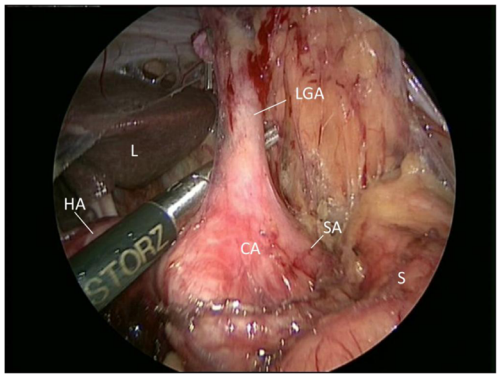

Fig. 7 Dissection taken to the left gastric artery (*LGA*) where it is ligated. Lymph nodes from stations 1 and 3a are included in the specimen prior to gastric transection. *HA* common hepatic artery, *L* liver, *SA* splenic artery, *CA* celiac axis, *S* stomach

Specimen Removal

The specimen is removed through an incision in the upper abdomen or around the umbilicus, or it can be removed through an incision in the lower abdomen. A wound protector is placed prior to removal. The incision is planned to allow space on the abdominal wall for a feeding jejunostomy, if required. Specimens are sent for intraoperative frozen section analysis of the proximal and distal margins prior to beginning reconstruction.

Gastrojejunostomy

The ligament of Treitz is identified and the jejunum is followed distally for 30–40 cm. We fashion a retrocolic anastomosis by creating a window in the transverse colon mesentery left of the middle colic vessels and leave the anastomosis cephalad to the transverse colon mesentery. Alternatively, an antecolic anastomosis can be completed, bringing the jejunum anterior to the transverse mesocolon. The jejunum is oriented along the posterior aspect of the stomach in an isoperistaltic fashion. The jejunum is approximated to the posterior wall of the stomach with a running 2-0 silk ENDOSTITCH™ suture. A gastrotomy and enterotomy are created with electrocautery. The ECHELON FLEX™ ENDOPATH® 60-mm bowel stapler is used to create a side-to-side, 6-cm anastomosis (Fig. 8). The remaining common channel is closed using the ENDOSTITCH™ with a 2-0 vicryl suture. It is best to close the corner of the opening on the surgeon's side first with a simple bite of the endosuture. Then, a second endosuture is used to close the enterotomy in a running fashion from left to right. An anterior inverting running layer is placed using a 2-0 silk suture with the ENDOSTITCH™ to Lembert the staple line and anastomosis. This suture is secured to the tail of the posterior layer previously left behind. To facilitate the anterior layer, a single, interrupted 2-0 silk suture may be placed and secured on the medial border of the stomach to allow a

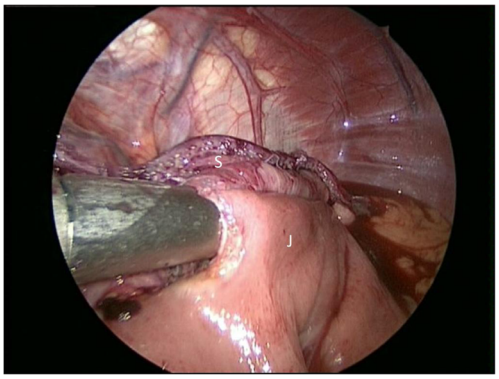

Fig. 8 Bowel stapler is used to create a side-to-side anastomosis after a posterior running layer is completed utilizing a 2-0 silk ENDOSTITCH™ suture. The common channel is closed utilizing a 2-0 vicryl ENDOSTITCH™ suture. An anterior layer of running 2-0 silk ENDOSTITCH™ suture completes the anastomosis. *S* stomach, *J* jejunostomy

"handle" to aid subsequent suture placement. If there is concern for narrowing the afferent limb, a 50-French bougie may be placed down the limb during closure to ensure its patency. All attempts are made to proceed with BII reconstruction, and this is performed as described above with up to an 80 % gastric resection. Roux-en-Y reconstruction is considered only if the resection volume is equal to, or greater than, 80 %.

Completion Endoscopy

Upon completion of the anastomosis, an upper endoscopy is performed. The internal aspect of the anastomosis is examined for patency. The abdomen may be filled with irrigation fluid and a leak test performed, if desired.

Optional Braun Enteroenterostomy

A Braun enteroenterostomy is sometimes performed to decrease complications seen with Billroth II reconstruction such as bile reflux into the stomach.[7] This can be completed laparoscopically or extracorporeally through the specimen extraction site. This is done in standard fashion with a 6-cm side-to-side anastomosis utilizing the laparoscopic stapler. It is placed 25 cm downstream from the gastrojejunostomy.

Closure

A laparoscopic feeding jejunostomy with a 16-French feeding tube is completed if necessary as we have previously described.[8] This is rarely utilized for distal, subtotal gastrectomy. However, on occasion, if the patient is very malnourished preoperatively, as determined by preoperative weight loss or nutritional studies, or has significant cognitive impairment, a feeding tube is more strongly considered. The specimen extraction site is closed in the standard fashion. The 12-mm port site is sutured closed (Fig. 9).

Results

We have utilized this operative approach in 11 patients with T3 or node-positive distal gastric adenocarcinoma from July 2012 to April 2014. This is a subset of a larger series which will subsequently be reported. There was one conversion to an open procedure due a large obstructing malignancy. Median number of lymph nodes retrieved was 23, and proximal and distal resection margins were negative in all cases. Median length of hospital stay was 6 days. There was no postoperative in-hospital mortality. Postoperative complications included one intraabdominal abscess and one episode of *Clostridium difficile* colitis. There were no intraoperative transfusions and the median blood loss was 100 ml.

Discussion

There has been significant debate over the use of minimally invasive techniques in gastric cancer. There is increased advocacy for the use of endoscopy with endoscopic mucosal resection and endoscopic submucosal dissection for the definitive management of early gastric cancer.[9] Similarly, laparoscopic approaches in early gastric cancer have been shown to have improvements in recovery time, pain, and pulmonary function with no reduction in curability.[1,2] In advanced gastric cancer, the major concerns with the laparoscopic approach are the completeness of the oncologic resection and D2 lymphadenectomy. Several trials have reported no difference in morbidity and mortality between the two approaches.[10,11] In a prospective randomized trial comparing open versus

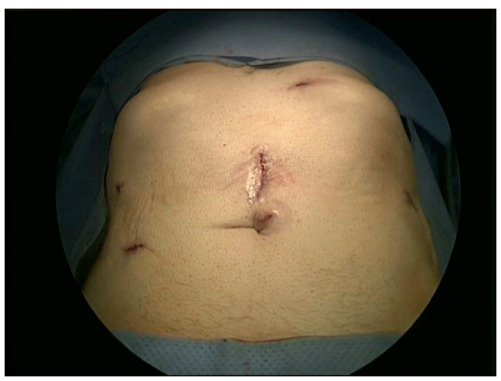

Fig. 9 Standard dermal closure covered by skin glue. Specimen extraction site can be at one of several sites on the abdominal wall depending on the preference of the surgeon. Typically, only a 3-cm incision is necessary for specimen extraction depending on the size of the tumor

laparoscopic distal gastrectomy for gastric cancer, Kim et al. reported improvements in intraoperative blood loss, total amount of analgesics used, the size of the wound, postoperative hospital stay, and quality of life parameters of global health for the laparoscopic group, supporting the use of this technique.[12]

There is, however, a learning curve associated with the use of laparoscopy in early gastric cancer and limited data for advanced gastric cancer. Kim et al. reported significant improvements in operative times after the first 50 cases but no difference in transfusion requirements, conversion rates, complications, or postoperative recovery between earlier experience cases and later experience cases.[13] Similar studies have reported the learning curve to range from 40 to 60 cases.[14,15] Once surgeons have ascended the learning curve, operative times are similar between the open and laparoscopic groups, supporting the use of laparoscopy with its improved postoperative outcomes.[15] In our experience, the learning curve is approximately 15–20 cases and surgeons following the approach outlined in this manuscript can achieve excellent results in the Western patient population.

Conclusion

In summary, we describe a technique for the laparoscopic management of advanced gastric cancer with subtotal, distal gastrectomy and D2 lymphadenectomy with Billroth II reconstruction. This method is appropriate for the majority of patients presenting with early or advanced distal gastric cancer who are candidates for surgical resection. This is our standard approach in the management of these patients. While there is a learning curve associated with the adaptation of this procedure, once the adequate technical skills are acquired, we believe its use results in oncologically acceptable outcomes with superior postoperative recovery.

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