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Case Report

A novel hand-assisted approach for laparoscopic D2 radical gastrectomy for gastric cardia cancer patients

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Abstract: We designed a hand-assisted device for laparoscopic D2 dissection for gastric cancer that allows the placement in peritoneal cavity of surgical instrument and the entry and maneuvering of the left hand of a surgeon. Here, we describe the surgical technique for radical resection of gastric cardia cancer using the hand-assisted laparoscopic technique. Our preliminary experience with three gastric cardia cancer patients shows that this new approach is safe, feasible and effective and may offer a cost-effective to other.

Keywords: Cardia cancer, laparotomy, laparoscopy, hand-assisted, TULS

Introduction

Gastric cancer remains the fourth most common cancer and the second most frequent cause of cancer mortality worldwide [1]. Radical gastrectomy for gastric cancer currently includes conventional surgery, laparoscopic radical gastrectomy and hand-assisted laparoscopic radical gastrectomy. Laparoscopic D2 dissection has proven safe and feasible for gastric cancer and has yielded comparable efficacy to open abdominal surgery. The laparoscopic approach has the advantage of more rapid postoperative recovery, reduced physical discomfort and fewer complications compared to the conventional method [2-4]. However, perigastric anatomical complexity increases the difficult of laparoscopic lymph node dissection [5]. We have designed a hand-assisted device which allows the operator's hand to be inserted into the abdomen during laparoscopic procedures.

Adenocarcinoma of the cardia has a lower curative resection rate and a poorer prognosis compared to carcinoma in other regions of the stomach [6]. Though the introduction of minimally invasive surgery and the use of laparoscopic techniques have significantly improved the surgical outcome of gastric cancer patients and improved restoration of intestinal continuity, gastric cardia cancer is often challenging to resect using minimally invasive surgical techniques. Though various devices have been employed for minimally invasive gastric surgery, none has been proven superior to others. We designed a patented hand-assisted device for laparoscopic D2 dissection that allows the placement in the peritoneal cavity of surgical instrument and the entry and maneuvering of the left hand of a surgeon. In the current paper, we describe the surgical technique for radical resection of gastric cardia cancer in three adult patients using the hand-assisted device.

Patients and methods

Patients

Three patients with pathologically proven adenocarcinoma of the cardia were selected for radical surgery by laparotomy and laparoscopy between June 2014 and July 2014 at Department of Gastrointestinal Surgery, the Second Hospital of Hebei Medical University, Shijiazhuang, Hebei, China. All three patients had received gastric endoscopy, chest x-ray examination, abdominal CT scan and pathological examination and other conventional examinations. They provided written informed consent to the operation.

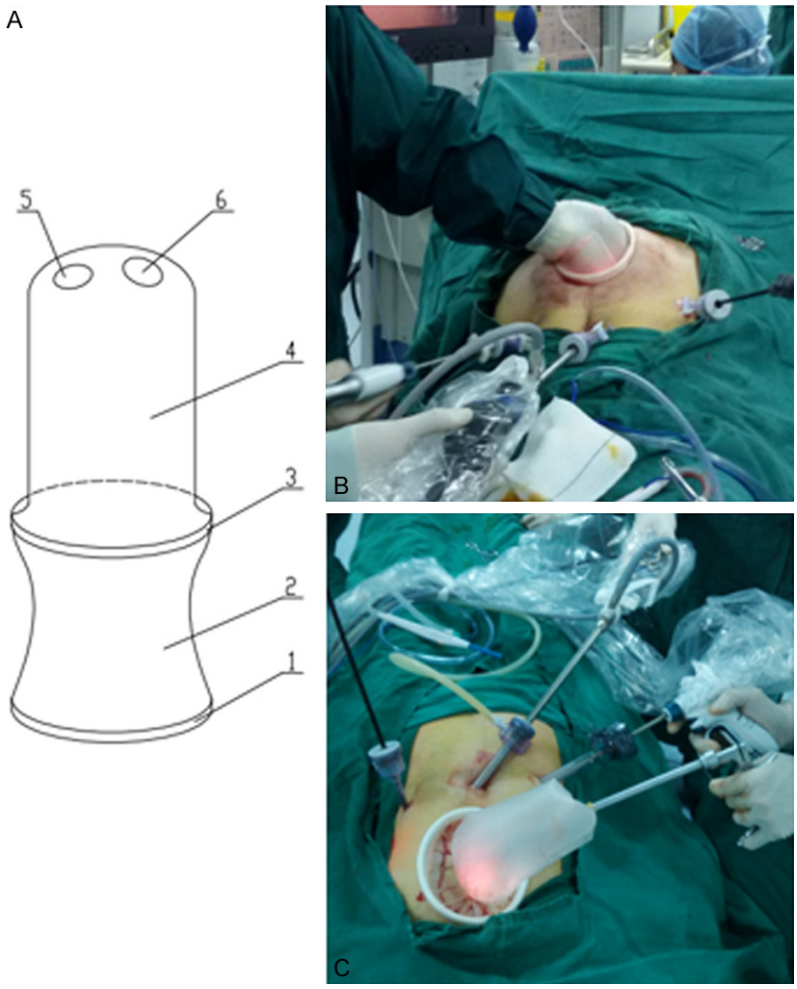

Figure 1. The hand-assisted device for laparoscopic D2 dissection for gastric cancer. A. The hand-assisted device consists of (1) the outer elastic ring, (2) the sealed connector, (3) the inner elastic ring, (4), the sealed sleeve, (5) the inlet for instrument, and (6) the inlet for hand. B. The entry of the left hand of the surgeon into the abdominal cavity via the device. C. The entry of surgical instruments into the abdominal cavity via the device.

The hand-assisted device

The patented device (patent No. 201220661-287.9) is illustrated in **Figure 1A**. It consists of an outer elastic ring, 2) a sealed connector, 3) an inner elastic ring, and 4) a sac-like sealed sleeve. The sleeve connects with the inner elastic ring on one end and has an inlet for inserting instruments and an inlet for inserting the hand on the other end. The device allows unhindered entry into the peritoneal cavity of the left hand to assist maneuvering in the exposed surgical field (**Figure 1B**) or instrument such as atraumatic grasping forceps, suction device or intestinal spatula without jeopardizing pneumoperitoneum (**Figure 1C**).

The surgical technique

The patients received general anesthesia under tracheal intubation and were placed supine. The positions of the surgeon and assistant surgeons are shown in **Figure 2** and the incisions and port placement are shown in **Figure 3**. A 10-mm incision was made right and inferior to the umbilicus to establish pneumoperitoneum (12 mmHg). A 10-mm trocar was left in the umbilicus as an observation orifice, and the laparoscope was entered to observe whether hepatic metastasis, distant intraabdominal metastasis, and metastatic nodules on the greater omentum, the peritoneal wall or inside the pelvis were present. A 5-mm trocar was entered 2 cm below the ribs at the left anterior axillary line as a second maneuver orifice. A longitudinal incision at a hand's width was made at the upper mid abdomen 3 cm below the xiphoid process. After the peritoneal cavity was entered, tumor size and tumor infiltration and metastasis were observed. The mid transverse colon and the greater omentum were retracted out of the incision. Then, the greater omentum and the anterior layer of transverse mesocolon were dissociated under direct vision in both directions along the transverse colon until the hepatic flexure and the splenic flexure of the colon were reached. Station 4d and 6 lymph nodes were removed along the right gastric artery and vein through the mesogastrium until the splenic flexure of the colon was reached. After removal of station 4sb lymph nodes, the greater omentum was folded over and returned to the peritoneal cavity to facilitate maneuvering of the laparoscope. The hand-assisted device was then entered and the surgical field was exposed by

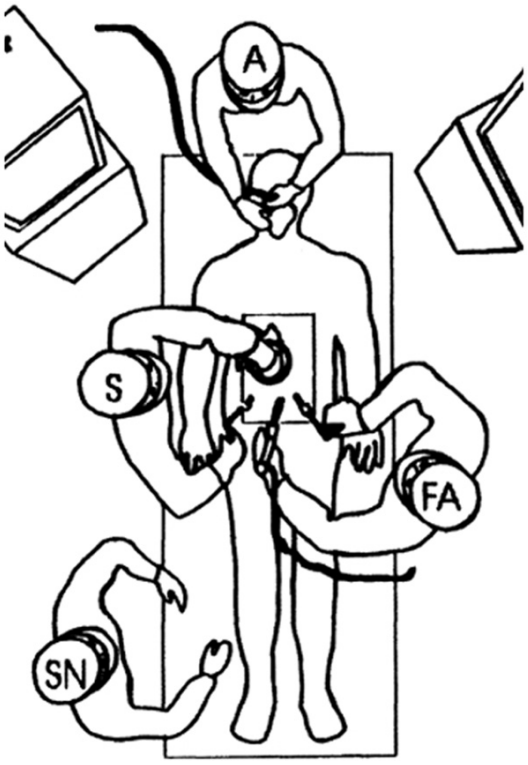

Figure 2. Positions of the surgeon and assistant surgeons using the hand-assisted device for laparoscopic D2 dissection. A: Anesthesiologist, who is typically near the patient head; S: Surgeon, on the right side of the patient; FA: First assistant, on the opposite side of the surgeon; SN: Second assistant or endoscope holder, on the right side of the surgeon.

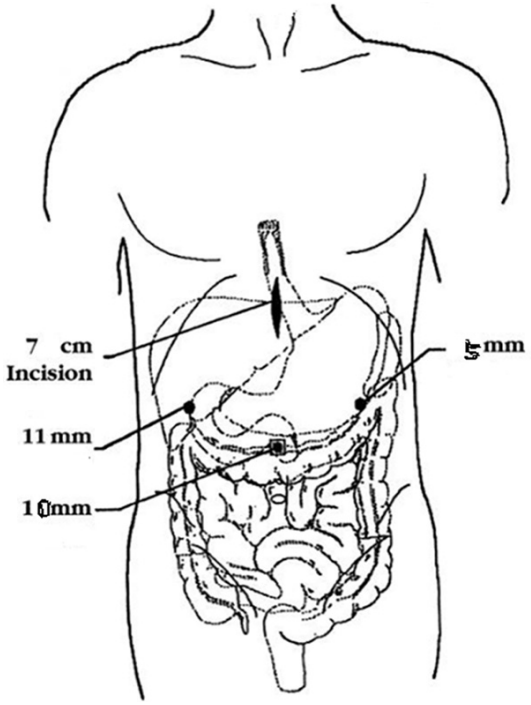

Figure 3. Incisions and port placement in hand-assisted laparoscopic D2 dissection. The upper mid abdomen incision is 7 cm in length and allows the entry of the patented the hand assisted device. The right incision, 11 mm in length, is the main maneuvering orifice, the umbilical incision, 10 mm in length, is the observation orifice and the left incision, 5 mm in length, is the minor maneuvering orifice.

two assistant surgeons. A 12-mm trocar was inserted at the right midclavicular line 2 cm superior to the umbilicus and served as the main maneuver orifice for the right hand of the operator and a 5-mm trocar was entered 2 cm below the ribs at the right anterior axillary line as a maneuver orifice for the left hand. The greater curvature of the stomach was dissociated to the left of the cardia, and station 4sb and 4sa lymph nodes were removed. Then, the gastroduodenal artery, and the right gastric artery were dissociated along the right gastroepiploic artery and exposed. The hepatic artery, the celiac trunk, the proximal splenic artery, and the left gastric artery were dissociated above the superior edge of the pancreas and exposed. The left gastric vein or coronary vein and the left gastric artery were clamped at the root and transected, and station 7, 8, 9, and 11 lymph nodes were removed. The retrogastric tissues were dissected until the posterior part of the esophagus was reached and the crua of the diaphragm were exposed. The hepatogastric ligament was excised along the inferior border of the liver to the right of the cardia and station 1 and 3 lymph nodes were removed. The vagal trunk was transected and a 6-cm segment of the lower esophagus was dissociated to dissociate and expose the proper hepatic artery.

After withdrawal of the instruments, station 12a lymph nodes were dissected under direct vision via the longitudinal incision at the upper mid abdomen. Station 5 lymph nodes were removed along the right gastric artery and dissection of station 7, 8, 9, and 11 lymph nodes was examined at the same time. The esophagus was transected with a purse string clamp about 4 cm above the tumor at the cardia and the stomach was retracted outside of the incision and the antrum was excised with an endo linear stapler. A 3-cm incision was made in the remnant stomach and a 26-mm round anastomosis stapler was advanced into the remnant

Table 1. Patient demographic and clinicopathologic data

Case	Sex	Age (years)	Tumor size, cm	Tumor location	Preoperative staging	Pathological type	Abdominal surgery
1	M	68	3×2×2	cardia	$T_2N_1M_0$	Moderately differentiated adenocarcinoma	No
2	M	65	4×3×3	cardia	$T_3N_1M_0$	Poorly differentiated adenocarcinoma	Yes
3	M	61	5×4×3	cardia	$T_4N_2M_0$	Signet-ring cell carcinoma	No

Table 2. Operative characteristics of the three patients

Case	Operative time, min	Estimated blood loss, mL	No. of lymph nodes	Length of hospital stay, d	Extubation time, d	Time to first flatus, h	Follow up, months
1	220	130	22	9	5	46	3
2	170	100	25	12	5	36	3
3	156	80	21	10	7	70	3

stomach via the incision and the esophagus and the remnant stomach were anastomosed with the stapler. Then, incision in the remnant stomach was sutured with an absorbable 3-0 suture. After drainage tube placement, the abdomen was closed.

Results

The demographic and clinicopathologic data of the three patients are shown in **Table 1**. They were all male and aged between 61 and 68 years. One patient had moderately differentiated adenocarcinoma, another had poorly differentiated adenocarcinoma, and the third had signet-ring cell carcinoma.

The operative data of the patients are shown in **Table 2**. Surgery was successful in all three cases and there was no conversion to open surgery. The operative time ranged from 156 to 220 min with an estimated blood loss of 80 to 130 mL. Twenty-one to 25 lymph nodes were dissected. The time to first flatus was 36 to 70 days. The extubation time was 5 to 7 days and the length of hospital stay was 9 to 10 days. Furthermore, no postoperative bleeding, intestinal fistula, anastomosis fistula, adhesive intestinal obstruction and wound infection were reported. The incision healed well and all three patients recovered and discharged. No recurrence or metastasis was observed at three months of follow up.

Representative case

A 68-year old male patient was admitted due to difficulty in swallowing and upper abdomen discomfort for two months. No fever, heartburn, hematemesis or melena and no abdominal pain were present. Gastroenteroscopy at a local hospital revealed ulcerative growth in the gastric cardia, which was approximately 40 cm from the incisors. The tumor was 3×2 cm in size and friable and biopsy showed presence of blood. The patient was diagnosed with gastric cancer and was referred to our hospital. CT scan suggested gastric cardia cancer and swollen lymph nodes in the lesser curve of the stomach. The patient underwent laparoscopic D2 dissection using the hand assisted device and the operation was uneventful. The operative time was 156 min and the estimated blood loss was 80 mL. A total of 21 lymph nodes were dissected. The time to first flatus was 36 days and the extubation time was 5 days. The patient discharged from the hospital 9 days after the surgery. No recurrence or metastasis was observed at three months of follow up.

Discussion

Laparoscopic D2 dissection for gastric cancer, though technically challenging, has achieved efficacy comparable to open radical surgery and accumulating evidence has demonstrated the feasibility and safety of the laparoscopic approach. The complexity of the anatomy of the perigastric space highlights the importance of adequate exposure of the surgical field and sufficient maneuverability of the surgical hand and instrument in the limited exposed field [7]. To overcome this limitation, we designed a hand-assisted device that allows unhindered entry of the left hand of the surgeon and surgical instrument. The operative time ranged from 156 to 220 min, which is shorter than open abdominal

surgery and the patients also had a shorter length of hospital stay. With shorter operating time and fewer trocars and other instruments required, the use of the hand-assisted device may provide significant cost savings compared to laparoscopic-assisted procedures.

The advantages of minimally invasive surgery are also achieved using the hand-assisted laparoscopic technique. The estimated blood loss was small (ranging from 80 to 130 mL) compared to conventional open surgery and the extubation time was also shortened (36 to 70 h). Moreover, the extent of lymph node dissection is equivalent to that of traditional open surgery. This is important as radical laparoscopic dissection of gastric cancer comes before minimal invasive injury, and if required, conversion to open surgery is recommended for a clean dissection. For inexperienced laparoscopist or in difficult cases, lymph nodes that are difficult to dissect can be saved for removal after the esophagus is transected during open surgery. Our hand-assisted device is simple in design and easy to maneuver and greatly reduces the technical difficult of laparoscopic D2 dissection. It also has less steep learning curve. The operating time for our patients was reduced from 220 min for the first patient to 156 min for the 3rd patient.

Our experience with three gastric cardia cancer patients indicates that the hand-assisted device allow surgeons to retain tactile feedback. Furthermore, the 3-dimensional perception is enhanced, and retraction and dissection are also improved. Laparoscopes and robotic surgeons have their limitations as they lack tactile feedback while our hand-assisted device allows the integration of opening the abdomen, hand assistance and laparoscopic dissection in achieving an effective and minimally invasive radical resection of gastric cardia cancer. Adenocarcinoma of the cardia has a low curative resection rate; our initial experience with the hand-assisted device suggests that this new approach is safe, feasible and effective. However, our findings need to be confirmed by a prospective controlled study.

Disclosure of conflict of interest

None.

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