



Reduced-port gastrectomy for gastric cancer with similar port arrangement to conventional five-port laparoscopic gastrectomy

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Abstract: In the recent years, approaches such as reduced-port surgery have garnered much attention because of their minimally-invasive nature and improved cosmetic outcomes. Many different types of reduced-port gastrectomy (RPG) for gastric cancer have been reported, and the optimal port size and their arrangement have not yet been established. The authors perform RPG for gastric cancer using an umbilical multi-channel port (MCP) and two needle forceps. In our procedure, a laparoscope and two 5-mm instruments are inserted through umbilical MCP (GelPOINT). The surgeon stands on the patient's right side and manipulates the conventional laparoscopic instruments through GelPOINT and right upper abdominal wall needle forceps. The first assistant on the patient's left side uses the forceps inserted through GelPOINT and the left upper abdominal wall needle forceps. Gastrectomy with lymphadenectomy and reconstruction are performed using the same technique as that of conventional five-port laparoscopic gastrectomy (LG). We have successfully used this procedure in over 60 patients with gastric cancer. Our technique for RPG employs the same number of instruments and similar port arrangement as used in conventional five-port LG. This procedure can also achieve almost the same postoperative pain reduction and excellent cosmetic outcomes as observed with single-port gastrectomy.

Keywords: Gastric cancer; reduced-port surgery; laparoscopic gastrectomy (LG); port arrangement; needle forceps

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Introduction

Ever since the first reported laparoscopy-assisted gastrectomy by Kitano *et al.* in 1994 (1), the procedure has been widely adopted as a mainstream approach, particularly in patients with early gastric cancer. The most commonly performed laparoscopic gastrectomy (LG) procedures normally use five ports of 5 or 12 mm in diameter. The laparoscope is inserted from the umbilical port, and four laparoscopic instruments are inserted from four ports setup in a reverse trapezoid shape in the upper abdominal region.

In the recent years, approaches such as reduced-port surgery, which includes single-port surgery, have garnered much attention because of their minimally-invasive nature and improved cosmetic outcomes. The technique has widely

been used for patients with cholecystitis (2) and colorectal cancer (3). LG with reduced-port surgery approach has been reported to be performed in patients with gastric cancer (4-11). There are many different types of reduced-port gastrectomy (RPG) for gastric cancer. These include single-port gastrectomy (7,8,11), which is performed through an umbilical incision only, and procedures wherein one (5,6), two (4,9,10), or three ports (11) are used in addition to the umbilical incision. Ports of various diameters of range 2–12 mm are used as additional ports. The optimal port size and their arrangement have not yet been established for RPG.

For performing RPG for gastric cancer, we place a multi-channel port (MCP) in the umbilical incision and two needle forceps each of 2.4 mm diameter on the left and

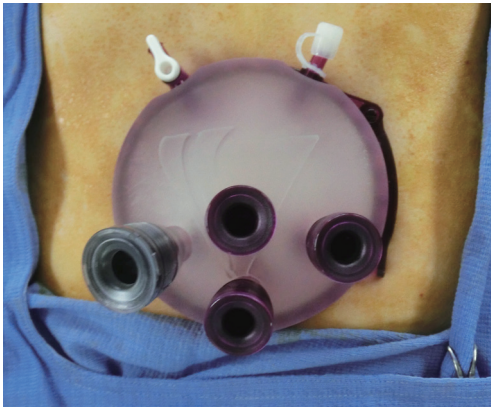


Figure 1 GelPOINT access platform is placed through umbilical incision. Four trocars (three 10 mm trocars and a 12 mm trocar) are positioned in the center, at the 6 o'clock direction, on the left side and right side.

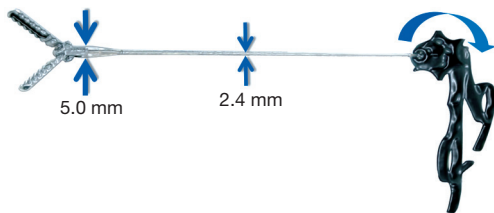


Figure 2 Endo Relief needle forceps, which have a 2.4-mm diameter rotatable shaft and a 5-mm diameter tip.

right sides of the abdominal wall. For umbilical MCP, we insert a laparoscope and two instruments so that, together with the two needle forceps added to the upper abdominal region, a total of four instruments are available for use. Our RPG procedure is performed using the same technique as that for conventional five-port LG. We hereby report in detail on the RPG procedure that we use for patients with gastric cancer.

Selection of patients

Based on the Japanese gastric cancer treatment guidelines (12), we consider patients with c-stage I gastric cancer (including cT1N0, cT1N1, and cT2N0) to be good candidates for LG, which includes both conventional five-port LG and RPG. For RPG, we insert the instruments that are to be held by the right hand of the surgeon from the umbilical MCP. In patients in whom the distance between the internal operation site and the umbilical region is large and

in those in whom the pancreas protrudes in the anterior direction, lymph node dissection in the suprapancreatic area is relatively difficult to perform. Accordingly, patients who have a large physique or are obese are not eligible for RPG. In terms of the resection method, RPG can be performed with the use of this technique for all procedures for which intracorporeal anastomosis is possible after gastrectomy. Thus, RPG is indicated for all types of gastrectomy, including total gastrectomy (TG), proximal gastrectomy (PG), distal gastrectomy (DG), and pylorus-preserving gastrectomy (PPG).

Procedure

The patient is placed in the supine position with the legs placed wide open. A horizontal or zigzag skin incision (13) of 3.0–3.5 cm is made in the umbilical region. For both these types of incision, a vertical incision is made in the fascia. MCP (GelPOINT access platform; Applied Medical, Rancho Santa Margarita, CA, USA) with four trocars is placed through the umbilical incision (*Figure 1*), and pneumoperitoneum is performed. Two additional needle forceps (Endo Relief; Hope Denshi Co., Ltd., Chiba, Japan) (14) are inserted into the left and right sides of the upper abdominal wall. Endo Relief forceps have a 2.4-mm diameter shaft and a 5-mm diameter tip (*Figure 2*). As the tip is thicker than the shaft, these cannot be inserted through the abdominal wall as done with conventional laparoscopic forceps. When setting these up in the abdominal wall, the 2.4-mm shaft is made to pierce the abdominal wall inside out from the peritoneal cavity and outside of the body where it is connected to the handle (*Figure 3*). In cT1 cases, these are directly setup on the abdominal wall without the use of a trocar. In cT2 cases, a 2.7-mm diameter trocar (Relief Port; Hope Denshi Co., Ltd., Chiba, Japan) made specifically for Endo Relief forceps is used to prevent recurrence at the port site.

The camera assistant positioned between the patient's legs inserts a flexible laparoscope through the GelPOINT trocar at the 6 o'clock direction or in the center. The surgeon stands on the right side of the patient and manipulates the conventional laparoscopic instruments from the right trocar on the GelPOINT with his right hand and right abdominal wall needle forceps with his left hand. The first assistant stands on the left side of the patient and uses the pre-bent forceps (Adachi-TANKO forceps; Adachi Industry Co., Ltd., Gifu, Japan) (*Figure 4*) inserted from the left side of the GelPOINT with his left hand and the left



Figure 3 Setup of Endo Relief needle forceps (15): 2.4-mm shaft is made to pierce the abdominal wall inside out from the peritoneal cavity and then it is attached to the handle outside of the body.

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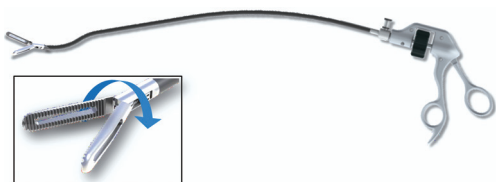


Figure 4 Adachi-TANKO pre-bent forceps, which have rotatable tip.

abdominal wall needle forceps with his right hand (*Figure 5*). The original liver retraction method using 2-0 prolene thread (Ethicon Inc., Cincinnati, OH, USA), which we have named the “Prolene anchoring method”, is used to retract the left lobe of the liver. First, a 2-0 prolene thread attached to a curved needle is passed through the peritoneum at the left subphrenic area, which is considered to be the most appropriate site for retraction, while the left lobe of the liver is lifted using forceps held with the surgeon’s left hand. Next, prolene thread is passed through the peritoneum at the subphrenic area on the right side of the esophageal hiatus and the peritoneum at the right subphrenic area. After detachment of the curved needle, each end of the thread is pulled out through the left upper abdominal wall and fixed for the retraction of the round ligament and the left lobe of the liver (*Figures 6,7*).

Four instruments are used to retract the organs and tissue and perform lymph node dissection and reconstructive techniques, and the procedure used are similar to those used for the conventional five-port LG (*Figures 8-12*). Reconstruction is performed with intracorporeal anastomosis. The linear stapler is inserted through the

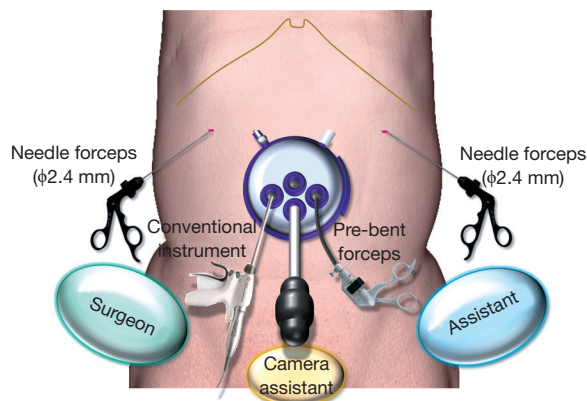


Figure 5 Port arrangement for reduced-port gastrectomy for gastric cancer: the camera assistant positioned between the patient’s legs inserts a flexible scope through GelPOINT. The surgeon on the patient’s right side manipulates the conventional laparoscopic instruments through GelPOINT and right abdominal wall needle forceps. The first assistant on the patient’s left side uses the pre-bent forceps through GelPOINT and the left abdominal wall needle forceps.

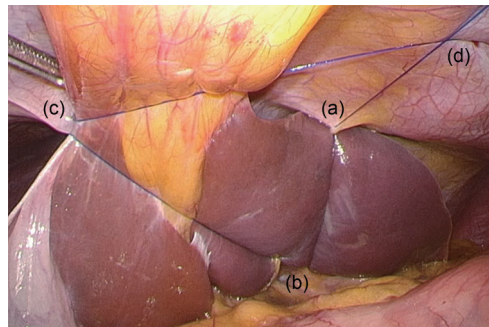


Figure 6 “Prolene anchoring method” for liver retraction: a 2-0 prolene thread with curved needle is passed through the peritoneum at the left subphrenic area (a), at the subphrenic area on the right side of the esophageal hiatus (b) and at the right subphrenic area (c). Each end of the thread is pulled out through the left upper abdominal wall (d) and fixed for the retraction of the round ligament and the left lobe of the liver.

GelPOINT 12-mm trocar, and the circular stapler is inserted directly through the GelPOINT GelSeal cup to be operated by the surgeon. After DG, Roux-en-Y or Billroth-I reconstruction [delta-shaped anastomosis (19)] is performed (*Figures 13,14*). After PPG, intracorporeal gastro-gastric end-to-end anastomosis is performed with linear staplers. In the case of TG, Roux-en-Y reconstruction is performed,



Figure 7 “Prolene anchoring method” for liver retraction (16). Available online: <http://www.asvide.com/articles/1469>

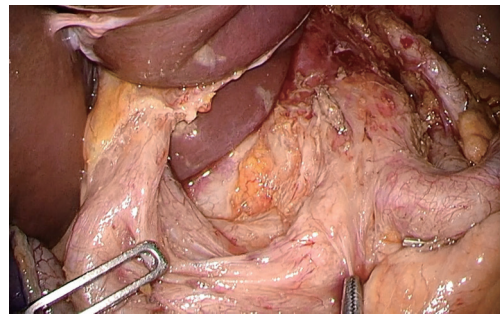


Figure 10 Final inspection after lymphadenectomy in the suprapancreatic area.

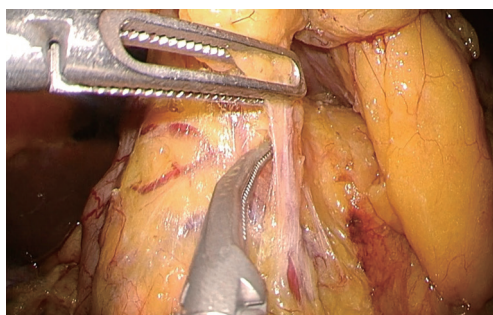


Figure 8 No. 6 lymph node dissection in the infra-pyloric area: the root of right gastroepiploic vein is exposed before clipping.



Figure 11 No. 6 lymph node dissection in the infra-pyloric area (17). Available online: <http://www.asvide.com/articles/1470>

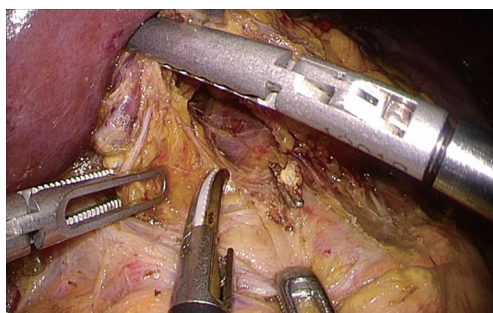


Figure 9 No. 8a & 9 lymph node dissection on the right side of the suprapancreatic area. For the adequate operative view and proper traction for dissection, we use four instruments to retract organs and tissue.



Figure 12 Lymph node dissection in the supraduodenal area and suprapancreatic area (18). Available online: <http://www.asvide.com/articles/1471>

and in the case of PG, jejunal interposition reconstruction is performed. Esophagojejunostomy in cases of TG and PG is performed using the Endo Stitch method (an adapted version of a method for intra-thoracic anastomosis

in thoracoscopic esophagectomy that we previously reported (21), which has been modified for use with esophagojejunal anastomosis) or the transorally inserted

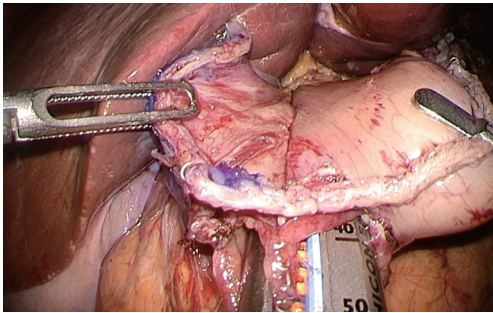


Figure 13 B-I reconstruction (delta-shaped anastomosis): the posterior wall of the remnant stomach and the duodenum wall are put together, and the stapler, which is inserted through an umbilical port with surgeon's right hand, is closed and fired. Then, the common incision is closed with a linear stapler, thus completing the delta-shaped anastomosis.

anvil (OrVil) method (22).

After reconstruction, a 5-mm diameter drain is placed through the umbilical incision. In some cases, such as DG with D1+ dissection or PPG, we do not place a drain postoperatively. After removal of the needle forceps and GelPOINT, the umbilical incision is sutured with absorbable sutures. The needle forceps wound is not sutured, but simply closed with wound-closure tape.

Tips, tricks and pitfalls

Owing to the fewer number of ports used, the RPG technique is more challenging than the conventional five-port LG as fewer instruments are available for organ and tissue manipulation. When a surgeon inserts the two instruments held in his/her left and right hands from a single incision, such as the umbilical incision, manipulation of the instruments is typically challenging and appropriate triangulation is difficult to achieve (23).

To address these shortcomings associated with RPG technique, we adjusted the port arrangement and the devices to develop a new RPG technique, which we have successfully used in over 60 patients with gastric cancer since 2011. Key aspects of our RPG technique are summarized below:

- (I) The technique allows the use of four instruments (two instruments inserted from MCP and additional two needle forceps). Because the same number of instruments can be used as in conventional five-port LG, the method confers the same leverage



Figure 14 B-I reconstruction (delta-shaped anastomosis) (20).

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- for organ and tissue manipulation as in the case of conventional five-port LG.
- (II) The surgeon is not required to insert two instruments held by both of his/her hands from a single port, but rather from individual ports, which helps avoid collision between the instruments and allows for similar appropriate triangulation as in conventional five-port LG.
- (III) Because the port arrangement is similar to the reverse trapezoid shape used for conventional five-port LG, organ retraction and lymph node dissection/organ resection can be performed with almost the same technique as used in conventional LG. Since the reconstruction technique is similar to that used in conventional LG, this RPG technique can be used for all types of gastrectomy for which post-gastrectomy intracorporeal anastomosis is possible.
- (IV) Because the tip of general needle forceps is small, it does not offer enough tissue holding strength and may cause damage to the tissues if not held deftly. However, because the tip of the Endo Relief forceps is of the same shape and size as that of the conventional 5-mm diameter forceps, it offers sufficient tissue holding strength, and the rotatable shaft can be operated intraoperatively in essentially the same manner as that in conventional 5-mm forceps. As the shaft diameter is extremely thin (2.4 mm), it minimizes postoperative pain. As the postoperative scar becomes invisible after a few months, the cosmetic outcomes of our technique are comparable to those of single-port gastrectomy (Figure 15).



Figure 15 Postoperative scar of reduced-port gastrectomy. The scars of needle forceps are almost invisible several months after surgery.

However, a limitation of this technique needs to be taken into account. The surgeon inserts right hand instruments including energy devices such as ultrasonically activated devices and electric cautery, forceps and clip applicators from the umbilical MCP. As already stated in the section on patient selection, patients who have a large physique or those who are obese have a large distance between the umbilical region and the internal site of operation and the pancreas tends to protrude in the anterior direction, which makes it relatively difficult to perform lymph node dissection in the suprapancreatic area in particular. Accordingly, RPG with our technique is not recommended for such patients.

In conclusion, our technique for RPG employs the same number of instruments and similar port arrangement as used in conventional five-port LG. We believe that our technique is a safe and feasible method for RPG that can be performed by all laparoscopic surgeons owing to the similarity in the methods. Our technique can also achieve almost the same postoperative pain reduction and excellent cosmetic outcomes as observed with single-port gastrectomy.

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Footnote

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Ethical Statement: The authors are accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved. All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee(s) and with the Helsinki Declaration (as revised in 2013). Written informed consent was obtained from the patient for publication of this manuscript and any accompanying images.

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