Video Article

Laparoscopic Low Anterior Resection with Total Mesorectal Excision for Rectal Cancer

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Abstract

Over the last few decades, laparoscopic total mesorectum excision has become a common procedure used in the treatment of stage I-III rectal cancers. When the tumor is located in the upper part of the rectum, low anterior resection (LAR) can be performed to remove the part of the rectum containing the tumor. In addition, faster recovery, less blood loss, and lower complications rates have been achieved by laparoscopic approach. In this protocol, the laparoscopic low anterior resection is performed through five cannulas. The rectum is mobilized with laparoscopic devices such as laparoscopic shears. The visceral and parietal pelvic fascia are dissected without injuring the hypogastric nerves and pelvic neurovascular bundles. The part of the rectum containing the tumor is removed and the colon is then attached to the remaining part of the rectum.

Introduction

In 1982, total mesorectal excision (TME) was introduced by a British surgeon, Heald[1], entailing an entire removal of the mesorectum, an adipose lymphatic tissue covering the rectum. Subsequently, low anterior resection (LAR) has become the preferred method for patients with rectal carcinoma, as opposed to abdominoperineal resection (APR), as LAR can preserve the sphincter.

Although radiotherapy and chemotherapy have significantly improved during the last few decades, appropriate surgical resection of the primary tumor remains the mainstay of curative treatments[2]. The anatomic position of the rectum makes TME via an anterior approach more difficult due to limited visualization of the lower pelvis[3,4].

Compared to open surgery, laparoscopic surgery has recently been proven to be a feasible alternative option for rectal carcinoma in terms of equalized oncological outcome. Additionally, laparoscopic LAR (LLAR) is suggested to be superior to conventional open surgery due to less blood loss, less pain, and a shorter hospital stay[5,6]. During an LLAR operation, the lesion is removed, the right planes are detected, and the hypogastric nerves and lumbar splanchnic nerves are well preserved. Thus, during the past two decades, the outcome of rectal resection for rectal carcinoma has been substantially improved[7]. With the development of the laparoscopic device, to date, laparoscopic total mesorectal excision has become an alternative approach to open surgery in patients with rectal cancer. The oncological outcome has also been confirmed by several high-level pieces of evidence[8,9]. The present work aims to describe a laparoscopic low anterior resection approach to remove a part of the rectum containing carcinoma.

Protocol

This protocol was performed according to the ethical guidelines of the Declaration of Helsinki and approved by the Ethics Committee of Ruijin Hospital affiliated to Shanghai Jiao Tong University School of Medicine.

1. Preparation for Surgery

1. Perform the procedure using routine general anesthesia[10,11], including preparation for GI tract decompression (including a bowel preparation and nasogastric tube placement), neuromuscular blockade, endotracheal intubation, and fluid management[12].
2. Monitor the patient monitoring with a system containing a noninvasive blood pressure monitor, an electrocardiogram, a neuromuscular junction monitor, pulse oximetry, an airway pressure monitor capnography, and a temperature monitor[13].

2. Position the Patient and Trocars

1. Position the patient in a steep Trendelenburg position. Dress the legs with padded podotheca. Place the legs on adjustable stirrups, and subject them to intermittent pneumatic compression on a mobile electrohydraulically operated surgical table.
2. Position both arms alongside the body routinely (or place the right arm at a 90° angle).
3. Have the surgeon stand on the patient's right side, the assistant on the left side, and the second assistant (camera operator) on the left side of the surgeon. Place the main monitor near the patient's left leg, and the second monitor near the patient's left shoulder.
4. Make the first incision at the umbilicus using the "open Hasson" technique to initiate a pneumoperitoneum (10 - 12 mm Hg) with a laparoscopic insufflation needle by using a High Flow Insufflation Unit (see **Table of Materials**).
5. Introduce the first 12 mm bladeless trocars (camera port, for the second assistant) when the pneumoperitoneum arrives at 12 mm Hg.
6. Tilt the operation bench to the right side to a moderate extent (10 to 30°) as well as head down to place the greater omentum and the transverse colon to the left upper quadrant under the supervision of the 30° laparoscopic camera.
7. Introduce the cannulas of the right middle (5 mm) and lower (12 mm) abdominal region (for the surgeon), and two ports (5 mm, 5 mm) on the left (for the first assistant) under the supervision of the 30° laparoscopic camera.
8. Perform a brief surgical exploration to identify the status of the greater omentum, small intestine, colon, and liver.
9. Retract the sigmoid colon out of the pelvic area to identify the tumor location. Perform a digital rectal exam or endoscopic examination under the supervision of a laparoscope to identify the tumor location. Determine the tumor location by intraoperative colonoscopy and mark the distal margin by titanium clips from the serosal side if needed.

3. Division of the Inferior Mesenteric Artery and Vein

1. Carefully and gently grasp (left hand) and lift up the anterior wall (right hand grasper) of the rectum and the pedicle of superior rectal arteries (SRA) as well as superior rectal veins (SRV) ventrally by the first assistant to extend the right-side peritoneum of the rectum by using the Kangji intestinal grasper (Bowl long).
   NOTE: For the demonstrated results here, the surgeon selected the medial side approach.
2. Start the dissection from the right, begun with monopolar cautery or ultrasonic shears at promontory level along the concave of peritoneum and toward the peritoneal reflection through the right lower quadrant trocar.
3. Use sharp and blunt dissection to incise the peritoneum, extend the subperitoneal fibrous tissues, identify the right plane, and separate the rectal fascia propria as well as the prehypogastric nerve fascia.
4. Identify and protect hypogastric nerves and lumbar splanchnic nerves carefully. Continue the dissection by using curved dissector and ultrasonic shears until the base of the inferior mesenteric artery (IMA).
5. Use an ultrasonic shear to divide the adipose tissues containing lymph nodes after the IMA has been identified, and use a Maryland grasper to skeletonize the IMA.
6. Sweep the lymph nodes at the base of the IMA to enable a robust lymph node harvest.
7. Seal and divide the IMA slightly distally by ultrasonic shears with 2x ligating Clips and 2x titanium clips to preserve the lumbar splanchnic nerves.
8. Divide the inferior mesenteric vein (IMV), as well as the left colic artery (LCA) at the same level as the division of IMA.

4. Mobilization of Lateral Part and Splenic Flexure

1. Expose the plane between mesocolon and Gerota's fascia by sharp division.
2. Dissect the left lateral plane along the white line of Toldt towards the splenic flexure. This plane meets the plane between mesocolon and Gerota's fascia. If necessary, dissect the splenic flexure in the lesser sac by ultrasonic shears until both dissection planes join at the splenic flexure edge.
3. Dissect the fibrous tissues between rectal fascia propria and pre-hypogastric nerve fascia starting from the right side through the right lower quadrant port, then from the left side.

5. Dissect the Rectum in a Posterior Fashion

1. Use gauze or a gauze dissector (optimal) to extend the space between planes.
   NOTE: Here, the surgeon selected a posterior fashion to dissect the rectum down to the bottom of the pelvis.
2. Carefully protect the sacral vessels during the dissection to the pelvic floor.
   NOTE: In dissecting around the rectum in the pelvis, dissect the superior rectal artery (SRA) carefully to avoid unexpected bleeding.
3. Dissect from posterior to the right to left peritoneal reflection. Dissect the presacral fascia and separate the bottom of the rectum from the pelvic fascia.

6. Anterior Dissection

1. After the incision of the peritoneal reflection, expose the rectoprostatic fascia (Denonvilliers' fascia). Protect the hypogastric nerves, seminal vesicles or vaginal wall carefully.
2. Open the anterior peritoneal reflection with shears just above the rectum. Protect the neurovascular bundles and the vaginal wall or prostate carefully.
3. Reach the pelvic floor at first the left and then the right anterolateral corners.
4. Divide the lateral ligament by ultrasonic shears and carefully preserve neurovascular bundles. Dissect anal-rectal ring when necessary.
   NOTE: When quite a low anastomosis or an intersphincteric resection is planned, the dissection of the connection of rectum and the levator ani muscle and the prostate and rectum are essential.

7. Transection of the Rectum

1. Skeletonize the rectum, and estimate the tension after anastomosis. Introduce and fire a tri-staple linear stapler across the distal rectum at proper angles.
2. Extend the umbilical wound in a craniocaudal direction for an additional 3 cm. Insert a wound protector and exteriorize the specimen outside the abdomen.
3. Perform the double-staple anastomosis intracorporeally by using a functional end-to-end circular surgical stapler.
4. Establish a preventative ileostomy after ultralow anterior rectal resection to decrease the incidence of anastomotic leakage.
5. Evaluate the circumferential resection margin to assure good formation of the staples.

8. Post-Operative Patient Care

1. Irrigate pelvic cavity with 200 mL warm saline.
2. Remove all the trocar ports.
3. Close the fascia of the mini-laparotomy with interrupted #0 sutures.
4. Irrigate and close the wounds with 4-0 subcuticular sutures. Apply closure strips and dress the wounds.
5. Laparoscopic low anterior resection results in less postoperative pain than conventional open surgery[14]; therefore, follow a multimodal approach to managing postoperative pain as previously reported[13,15].

Representative Results

Intraoperative data

In this protocol, the surgeon selected the medial side approach. The anterior wall of the rectum was lifted up to extend the right-side peritoneum of the rectum. The surgeon used an ultrasonic shear to dissect the peritoneum at promontory level along the concave of peritoneum and toward the peritoneal reflection (**Figure 1A**). In this protocol, the surgeon used sharp and blunt dissection to incise the peritoneum, and identify the correct plane without any injury of the ureter (**Figure 1B**). When the surgeon completely skeletonized the IMA, the hypogastric nerves were also identified and protected carefully (**Figure 1C**). **Figure 1D** shows the preservation of the left colic artery (LCA) in laparoscopic low anterior resection; the superior rectal artery (SRA) was ligated. The left colic artery (LCA) and superior rectal artery (SRA) were divided.

Early postoperative data

The observed rate of R1 resection for the entire patient cohort was 1.4%. Concerning the post-operative complications, anastomotic leakage happened in 7% of patients. Specifically, in the group with preservation of the left colic artery (combined with lymph node dissection), the anastomotic leakage rate was 5%; in the corresponding non-preservation group, the leakage rate was 7%. Concerning the quality of TME, among the 104 resections from 2015 to 2017, 95% were mesorectal resection, 5% were intramesorectal resection.

In our previous study, the laparoscopic TME has been evaluated for rectal cancer patients with elevated operative risk, which was defined as Cr-POSSUM > 5% combined with associated risk factors. The 5-year overall survival rate of these patients was between 65% to 75%[16].

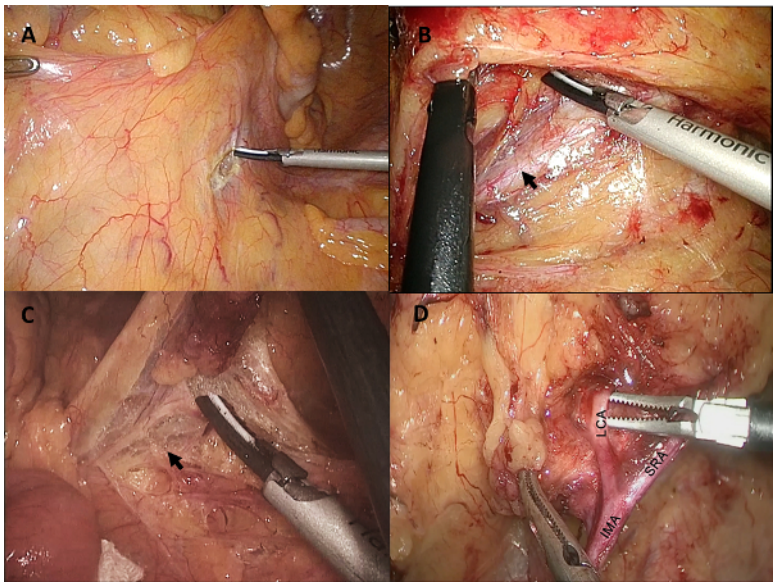

Figure 1: Intraoperative results. (A) The right-side peritoneum was dissected by an ultrasonic shear at promontory level. **(B)** The correct plane is identified, and the ureter (black arrow) was carefully identified and protected during the dissection. **(C)** When dissecting the base of the IMA, the hypogastric nerves (black arrow) were also identified and protected carefully. **(D)** The skeletonized IMA in laparoscopic low anterior resection; the left colic artery (LCA) and superior rectal artery (SRA) were divided. Please click here to view a larger version of this figure.

Discussion

Over the last three decades, total mesorectum excision (TME) was considered the gold standard for rectal cancer resection. Currently, it has been found by several randomized clinical trials that the oncological outcomes and long-term survival rates were equivalent between open and laparoscopic TME in the treatment of rectal cancer[17,18,19]. In addition, shorter hospitalization and faster recovery, lower blood loss and lower complications rates were achieved by laparoscopic approach[16,20]. However, considering the long learning curve and technical difficulties, the application of this surgical approach was mainly limited to several specialized surgical centers[21].

When we perform the anterior dissection of the rectum, sometimes we found that the neurovascular bundle tightly adhered to the rectum. The surgeon should pay attention not to enter into the neurovascular bundle; instead, the surgeon should evert the neurovascular bundle from the rectum. For an intersphincteric resection (ISR) or an ultralow anterior rectal resection, the surgeon needs to caudally advance the dissection between the rectum and the levator ani muscle posteriorly.[22]

Recently, it was reported that ninety laparoscopic TME operations were required for a surgeon to achieve comparative oncological safety[23]. It was suggested that case accumulation and standardized procedure were essential to achieve high clinical performance. Though a robot-assisted approach could potentially overcome a few limitations of conventional and laparoscopic rectal resection in the narrow pelvic cavity, it still needs to be further validated[24]. Meanwhile, a few retrospective studies suggest an advantage of transanal TME (TaTME) in low rectal cancer compared with the transabdominal approach; however, evidence of higher level needs to be explored[25].

In addition, the acceptable oncologic and functional outcome after transanal extraction of the rectal specimen shed light on the preservation of the abdominal wall in the laparoscopic low anterior resection[26]. The laparoscopic low anterior resection (LLAR) could be performed either in a medial approach or lateral approach[22,27]. Here, the medial approach was selected. Alternatively, if the lateral approach is chosen, the left lateral plane should be exposed first after the dissection of the white line of Toldt.

Reports have shown that the postoperative anastomotic leakage rate is 5 - 26% for rectal cancer. Controversially, it seems that the preservation of the left colic artery (LCA) in laparoscopic low anterior resection was associated with less anastomotic leakage[28,29], Left colic artery (LCA) preservation combined with lymph node dissection might be an alternative approach to perform the laparoscopic low anterior resection.

Disclosures

None of the authors have competing or conflicting interests.

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