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Robotic low anterior resection

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A B S T R A C T

The surgical robot is an ideal instrument for use in the pelvis and on the rectum. A low anterior resection can be performed using a totally robotic technique or a laparoscopic hybrid approach. The pre-operative planning for a robotic approach is similar to that of a laparoscopic or traditional open approach. The robotic approach is ideally suited for patients with low or middle rectum pathology, and the only absolute contraindication is inability to tolerate pneumoperitoneum. The operation is performed using four robotic trocar sites, as well as camera and assistant ports. The entire operation can be performed without repositioning the robotic console. There are few potential complications unique to the robotic approach, and the outcomes of robotic low anterior resection appear similar to that of the laparoscopic approach. This article describes the technique of a robotic low anterior resection, including splenic flexure mobilization, total mesorectal excision and specimen extraction, and well the peri-operative management.

Introduction

Rectal cancer remains a prevalent disease within the United States, with an estimated 39,610 new diagnoses in 2015.[1] Despite advances in chemotherapy and radiotherapy, surgical resection remains the best chance for cure. Low anterior resection (LAR) with a total mesorectal excision (TME) has become the accepted standard for rectal cancer surgery. An LAR with TME entails complete excision of the tumor and surrounding mesorectal envelope and lymph nodes as an intact unit, while preserving the underlying autonomic nerves. The anatomical constraints of the pelvis make rectal surgery a technically difficult operation. Laparoscopy has allowed surgeons to operate with more ease and more finesse within the pelvis. However, because of the inherent limitations of the laparoscopic tools, such two-dimensional imaging and restricted degrees of motion, laparoscopic rectal operations remain challenging.

Robotic-assisted surgery provides the benefits of minimally invasive techniques with the added ability of very precise dissection and three-dimensional imaging, making the surgical robot an ideal instrument for use in the pelvis and on the rectum. The design of the first generation da Vinci system (Intuitive Surgical Inc, Sunnyvale, CA) made totally robotic rectal surgery difficult, requiring a hybrid approach. With this technique, the initial colon and splenic flexure mobilization is performed laparoscopically. The robot is then docked in the middle of the operation for the subsequent robotic rectal dissection. The newer da Vinci models—especially the Xi system—offer longer instruments and greater degrees of movement. These advancements allow for access to multiple areas of the abdomen and pelvis without repositioning the robot or an initial laparoscopic mobilization. Surgeons now have the ability to perform a rectal surgery completely robotically. In this article, we describe the techniques for a totally robotic LAR as well as a hybrid approach, in which the splenic flexure mobilization is performed laparoscopically, and the TME is performed robotically. Neither approach is superior to the other, nor should the choice of technique should be made based on surgeon preference and skill.

Pre-operative planning

Once a patient is diagnosed with rectal cancer, optimal management involves a multidisciplinary approach with medical oncology and radiation oncology in addition to surgical oncology. This team effort allows the patient to be evaluated for neoadjuvant and adjuvant therapy, and undergo these treatments in a timely fashion. We also recommend consultation with an ostomy nurse for counseling and skin marking in the event that an ostomy is warranted during the operation. In our practice, we routinely use a mechanical bowel preparation with a polyethylene glycol solution prior to low anterior resections.

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As with traditional open or laparoscopic rectal resections, patients with rectal cancer undergoing a robotic resection should have a complete work-up prior to the operation. The specifics of the work-up will vary by medical center and surgeon, but should include the following:

(1) A complete history and physical to assess for comorbid conditions.
(2) A digital rectal exam and sigmoidoscopy performed by the surgeon to confirm the level of the lesion (even if a colonoscopy has been performed previously).
(3) A complete colonoscopy to assess for synchronous lesions.
(4) Pelvic imaging (MRI or undorectal ultrasound) to identify depth of invasion and suspicious lymph nodes.
(5) CT imaging of the chest, abdomen and pelvis to evaluate for metastatic disease.

Robotic low anterior resection is ideally suited for tumors in the mid-rectum (5–10 cm from the anal verge) and low rectum (0–5 cm from the anal verge). In order to perform a low anterior resection (robotic or otherwise) the tumor must have at least a 1 cm margin distally to allow stapled anastomosis. Very low tumors may require an inter-sphincteric resection. Tumor of the upper rectum (> 10 cm from the anal verge) can still be approached robotically. However, the advantages of the robot are less apparent for tumors, high in the pelvis.

The only absolute contraindication to a robotic low anterior resection is inability to tolerate pneumoperitoneum (patients who are hemodynamically unstable or with severe cardiac or pulmonary disease). This fragile state would similarly limit a laparoscopic approach and would likely result in increased risk of morbidity or mortality in an open operation. Otherwise, the ability to perform a robotic LAR is dependent on surgeon experience and comfort.

Operative technique

The operative technique described in this section is based in the da Vinci S or Si models and can be adapted for the fourth generation Xi model. With this approach, the entire procedure, including the splenic flexure mobilization, can be performed without repositioning the robotic system. The first generation da Vinci Surgical System does not offer the same capabilities as the newer models and therefore requires a hybrid approach.

Positioning and preparation

After induction of anesthesia, the patient is placed in a modified lithotomy position with adjustable stirrups such that the hips are flexed and slightly abducted. The ipsilateral shoulders, hips, knees, and feet should form a straight line. Both arms are tucked along the body to allow for docking of the robot and room for an assistant. All boney prominences must be well padded to avoid a pressure injury from the bed, stirrups, assistant, or robot. The patient is well secured to the bed to prevent shifting during movement of the table. A nasogastric or orogastric tube should be placed for gastric decompression. A Foley catheter should be placed for urinary bladder decompression.

The rectum is irrigated with 1–2 l of a dilute betadine solution to complete the bowel preparation. Routine placement of ureteral stents by is not recommended. The abdomen is then prepped in the standard sterile fashion. The assistant surgeon will work from the patient's right side while the robotic cart is docked from the patient's left side. Docking the robot at the left hip (rather than from the perineum) will allow easy access to the perineum during the operation. The scrub technician will also work from the patient's right side. Pre-operative antibiotics to cover intestinal flora should be given routinely (Fig. 1).

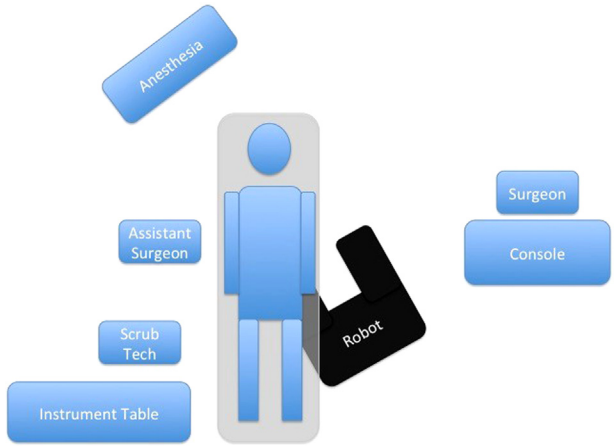

Fig. 1. Operating room configuration.

Port placement (fully robotic technique)

The description that follows is suited especially for the Si model of the da Vinci system. The port placement of the Xi is thought to be simpler and consists of a straight line approach against the target organ. Pneumoperitoneum is established with a Veress needle in the left upper quadrant (Palmer's point). The camera port (C, 12 mm) is placed first, halfway between the xyphoid process and symphysis pubis in the midline or slightly to the right in patientrs with very small body habitus. Placement of the camera at this location allows for visualization of the left side of the abdomen and the pelvis from a single position. Next, all quadrants of the abdomen should be inspected for Veress needle injury or evidence of previously unknown metastatic disease. Once the survey is complete, two robotic (8 mm) ports are placed: one in the right lower quadrant (R1) and the other in the left lower quadrant. They are placed at least 8 cm away from the camera along a line that connects the camera to the anterior superior iliac spine, typically where this line crosses the midclavicular line. This location will place the first and second robotic ports approximately 14–16 cm from the pubic symphysis. A third robotic port (R3, 8 mm) is placed in the epigastrium, approximately 5 cm inferior to the xyphoid and to left of the falciform, which will be used in the initial mobilization portion. A fourth robotic port (R4, 8 mm) is placed in the left lower quadrant, approximately 8 cm lateral to R2 and superior to the anterior superior iliac spine, which will be used in the rectal dissection. An assistant port (A, 12 mm) is then placed in the right upper quadrant, approximately 8–10 cm cephalad to the right lower quadrant robotic port, along the midclavicular line. This port can be used for retraction, suction or stapling. A second-assistant port (5 mm) can be placed if necessary, and can provide additional retraction. The ideal location for this second-assistant port is again in the right upper quadrant, approximately 5 cm cephalad to the first assistant port. This port placement will allow for triangulation during both the mobilization and pelvis dissection portions of the operation (Fig. 2).

Robot docking

The robotic cart is then docked along the patient's left hip. The cart should be angled at about 30° from the table. For the first portion of this operation, only the right lower quadrant (R1) and