Robotic Intersphincteric Resection and Abdominoperineal Resection for Low Cancer

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11.1 Background

Despite the exponential diffusion of robotic surgery in the whole field of colorectal surgery, its application is best suited for highly demanding procedures such as those required to treat low-lying rectal cancer [1]. Growing evidence exists supporting possible advantages of robotic surgery over conventional laparoscopic techniques in performing rectal anterior resection with intersphincteric resection (ISR) and robotic abdominoperineal resection (APR) [1–3]. Herein we examine the technical details of our practice of performing ISR and APR using a fourth-generation, four-arm surgical robot (da Vinci Xi, Intuitive Surgical, Sunnyvale, CA).

11.2 Equipment, Patient Positioning and Operating Room Setup

Recommended main equipment for both ISR and APR procedures:

- 30° endoscope
- 0° endoscope
- fenestrated bipolar forceps

Supplementary Information The online version contains supplementary material available at https://doi.org/10.1007/978-3-031-33020-9_11.

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G. Ceccarelli, A. Coratti (eds.), *Robotic Surgery of Colon and Rectum*, Updates in Surgery, https://doi.org/10.1007/978-3-031-33020-9_11

– monopolar scissors
– large needle driver
– VesselSealer (optional)
– laparoscopic endostapler: 60-mm blue cartridge.

The patient is initially placed in a lithotomy Trendelenburg position (modified Lloyd-Davis) with both arms abducted on arm boards and the legs are placed on stirrups. Adequate soft padding is provided to prevent pressure-related injuries. Generally, a 20° Trendelenburg position is given, with a steep right lateral tilt (15°). The bedside surgeon(s) is on the right of the patient. Pneumoperitoneum is obtained using the Veress needle in the left hypochondrium. A standard laparoscopic 10–12-mm port (L1), and five robotic 8-mm ports (R1–R5) are placed as illustrated in Fig. 11.1. Unlike most other surgical teams, we favor the use of the assistant retraction instrument (i.e., the tip-up grasper) through the robotic port on the right side of the surgical field. We do believe such port configuration has distinct advantages in terms of exposure during pelvic dissection as compared to the conventional specular positioning, while not impairing traction assistance during the remainder steps of the procedure. The peritoneal cavity is firstly inspected to confirm the preoperative diagnosis and rule out metastatic or concomitant disease. The greater omentum is lifted cranially over the transverse colon. The small bowel is carefully displaced cranially and to the right until adequate visualization of the retroperitoneal plane is achieved, ideally from the promontory to the ligament of Treitz. We routinely employ a single-docking technique by positioning the cart of the robot beside the left lower quadrant of the patient, which allows the arms to cover the entire range of movements required in both the abdominal and pelvic phase of the procedure. When moving from the abdominal to the pelvic phase of the procedure, the bipolar forceps in R4 is moved to the R5 access in the left flank (Fig. 11.1) and the targeting is

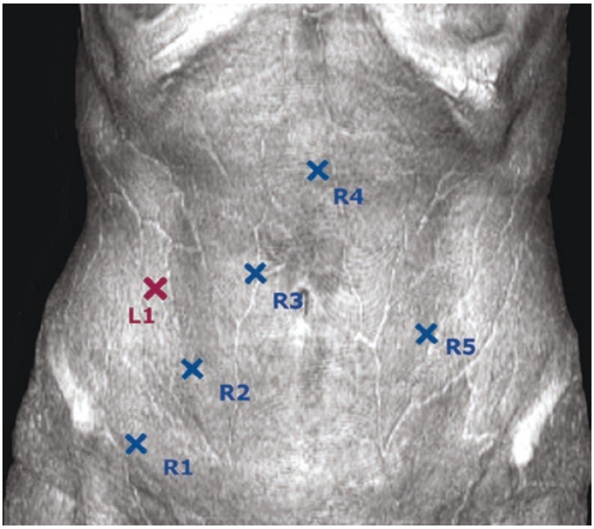

Fig. 11.1 Port setting in robotic intersphincteric resection for a low-lying rectal cancer

re-done, pointing at the midline of the pelvis. Typically, R2 is used for the monopolar scissors, which we favor for all dissections. The bipolar fenestrated forceps and the tip-up grasper are mounted on R4 and R1, respectively. The bedside surgeon utilizes the laparoscopic access (L1) to introduce gauzes and threads, and deliver irrigation and suction, as needed. The R2 port is usually placed at the site of future ileostomy, to limit surgical incisions. Similarly, R5 is usually positioned at the intended side of colostomy in the case of APR.

11.3 Technique/Procedure

The tip-up forceps in R1 grasps the distal sigmoid/sigmoid-rectal junction to put it under traction anteriorly and upwards to visualize the groove underneath the inferior mesenteric artery (IMA) at the level of the sacral promontory. This maneuver promotes stretching of the mesenteric-mesocolic fold which is scored transversally just medial to the right common iliac artery. This allows identification of the avascular plane to be dissected along the inferior aspect of the ileopelvic mesocolon and mesorectum, while maintaining the genitourinary and nervous structures such as the left ureter, gonadal vessels and hypogastric nerves just beneath the retroperitoneal layer. This avascular, inframesocolic window is taken from medial to lateral, with careful attention to avoid any thermal injury to the retroperitoneal structures. To do so, the tip-up grasper provides continuous traction of the ileopelvic mesocolon to the left and upwards toward the anterior abdominal wall, while the dissection is led using both the bipolar forceps in R4 and monopolar scissors in R2 with minimal electric dispersion. Cephalad dissection permits easy identification of the origin of the IMA along with the superior hypogastric plexus. Once the left ureter, left gonadal vessels, and origin of the hypogastric nerves are visualized, IMA is circumferentially isolated, skeletonized and divided between hem-o-lok clips. The IMA is divided proximally to obtain adequate clearance of the lymphatic and fatty tissue around its aortic origin, while ensuring adequate distance from the level of the superior hypogastric plexus, required for its careful preservation.

The tip-up grasper is now introduced underneath the inframesocolic window, which is gently elevated. The caudal portion of the ligament of Treitz is divided with utmost respect for the duodenojejunal flexure. The inferior mesenteric vein (IMV) is thus easily exposed right below the inferior border of the pancreas, prepared and divided between hem-o-lok clips. This permits further medial-to-lateral and cephalad dissection between the Toldt's fascia anteriorly and the Gerota's fascia posteriorly. This dissection is usually led as far as possible in both a lateral and cranial direction. A small gauze is usually introduced and pushed cranially and laterally into this window to facilitate subsequent dissection.

By retracting cranially the greater omentum, whose free inferior margin has been overturned over the transverse mesocolon and the stomach, the greater omentum is freed from the transverse colon to enter the lesser sac. This maneuver usually commences just to the left of the median line. Once the lesser sac is entered - this is confirmed by direct visualization of the posterior aspect of the stomach - the remaining attachments between the greater omentum and the splenic colonic flexure are dissected to the level of the inferior pole of the spleen. The splenocolic ligament and the so-called plica spleno-omentalis (also known as criminal fold of Morgenstern) are then carefully divided avoiding any undue traction maneuver [4]. The remaining transverse mesocolon must be dissected at its origin, just a few millimeters away from the pancreatic capsule, to completely release the distal transverse mesocolon along with the splenic flexure. To do so, the lateral attachments of the splenic flexure to the parietal peritoneum of the abdominal wall are first divided with a lateral-to-medial approach and the previously developed plane underneath the mesocolon is thus encountered, generally easily identifiable by the presence of the gauze, bulging through the thin layer of the transverse mesocolon itself. Having done this, the left portion of the root of the transverse mesocolon is divided proximally, up to the middle colic trunk. For the achievement of this step, we generally favor a superior, lateral-to-medial approach, although the inframesocolic route or a medial-to-lateral dissection may be used on a case-by-case basis. During the entire procedure of splenic flexure takedown, the use of the VesselSealer may aid in the presence of significant visceral obesity, though we do not recommend its routine use.

The camera arm (R3), now mounted with a 0° endoscope is re-targeted to the midline of the pelvis, while the bipolar forceps are moved to the robotic port in the left flank (R5). The bedside surgeon(s) remains on the right side of the patient, now employing the upper robotic port (R4) as a second access used to retract the sigmoid-rectal junction out of the pelvis. In female patients, the uterus is usually anchored to the anterior abdominal wall via a monofilament thread passed through the uterine fundus for better exposure. The descending and sigmoid colon are now mobilized, developing caudally and laterally the already created plane of dissection. In typical situations, this maneuver is almost bloodless and straightforward. With the help of gentle traction by the tip-up grasper of the upper rectum upwards and anteriorly, posterior dissection continues following the course of the superior rectal artery. This dissection is conducted in the avascular "holy" plane between the mesorectal fascia superiorly and the presacral Waldeyer's fascia inferiorly, thus preserving and leaving intact the underlying hypogastric nerves. The incision of the visceral peritoneum of the distal sigmoid is progressively prolonged caudally on both sides of the upper rectum, and then anteriorly, where the dissection proceeds along the recto-vaginal septum/the Denonvilliers' fascia (see Video 11.1). During this maneuver, the tip-up grasper in R1 has a crucial role in retracting and preserving such structures anteriorly. Laterally, a combination of traction and countertraction by the tip-up grasper and the bipolar forceps is of utmost importance to carefully identify the lateral aspects of the perirectal fascia and the rectogenital septum or Denonvilliers' fascia, which laterally fuses with the lateral pelvic fascia. Precise identification of such structures is particularly important in allowing complete preservation of the autonomic pelvic plexus and the so-called neurovascular bundles of Walsh. The middle rectal arteries are inconstantly encountered during lateral dissection as piercing on both sides the perirectal fascia. They are generally controlled with bipolar energy and easily divided. The TME dissection is taken down to the pelvic floor, until the distal rectum is completely and circumferentially isolated from the plane of the levator ani muscle, where the mesorectum thins out and is virtually absent.

11.3.1 Intersphincteric Resection

The so-called intersphincteric plane should now be entered. To do so, the so-called hiatal ligament, on the posterior aspect of the longitudinal muscle of the rectum must be cut firstly. The plane between the external surface of the longitudinal muscle of the anal canal and the internal surface of the external anal sphincter (EAS) is followed and developed as distally as needed to ensure free distal resection margins, ideally aiming at a 1-cm clear margin (see Video 11.1). Anterior and posterior dissection is generally more technically demanding as compared to lateral mobilization, owing to the intimate contiguity of the longitudinal muscle of the rectum to the rectourethralis muscle, and the anococcygeal ligament, respectively. However, entire excision of the internal anal sphincter (IAS) is not mandatory in all patients and a subtotal or partial ISR can be also performed depending on tumor location and length of the anal canal itself. The abdominal phase of the procedure terminates with the identification and isolation of the site of the future ileostomy in the distal ileum using a tape or a vessel loop. The robot is now undocked and transanal dissection follows. The patient is positioned in the lithotomy position. Usually, the Lone Star (CooperSurgical, Trumbull, CT, US) retractor system is employed during perineal dissection. The anal mucosa along with the corresponding IAS is scored circumferentially at the intended level of distal margin. The anorectal junction/rectum is thus carefully dissected free of the EAS and the levator ani circumferentially, until the transabdominal dissection plane is encountered. The future specimen is thus passed through the residual anal canal and delivered to the outside. Proximal division at the descending colon is then carried out after careful assessment of local microcirculation adequacy by indocyanine green fluorescence imaging, using the Firefly function. To fashion a coloanal anastomosis, the proximal colonic stump is firstly anchored to the EAS, just cranially to the mucosal section, and then the residual anal canal is anastomosed to the proximal colon using full-thickness, absorbable 4/0 interrupted sutures. Four cardinal stitches are initially placed, followed by two further stitches to each of the derived quadrants. The ileostomy loop is exteriorized in the right flank, usually enlarging the R2 port access. One drain is usually placed in the pelvis posterior to the transposed descending colon. Port incisions are closed and the loop ileostomy is opened.

11.3.2 Abdominoperineal Resection

During APR, splenic flexure release is generally not needed, and partial mobilization of the descending colon is usually sufficient to create a tension-free colostomy in the left flank. The vascular phases of the procedure, as well as TME dissection are performed in the same manner as for ISR. The descending colon, at the intended level of proximal resection, is now prepared along with its mesocolon. The marginal arcade is identified, doubly ligated and divided. The corresponding colon is thus transected using a linear endostapler. Subsequent dissection differs from ISR in that, once the plane of the levator ani muscle is reached, further dissection through the hiatal ligament and the raphe of iliococcygeus and pubococcygeus muscle is commenced in a perpendicular direction through the perineum, to encompass the entire EAS complex in the resection. Such posterior dissection is then prolonged laterally, and the pelvic floor is divided bilaterally. Any hematic oozing is carefully controlled with the bipolar forceps, to facilitate subsequent perineal rendez-vous. Dissection of the anterior aspect of the anorectum follows, which proceeds transabdominally as deep as possible, mostly using the scissors with minimal energy dispersion and constant care paid to avoid any direct or thermal damage to the vagina or membranous urethra. Finally, from the left portion of the greater omentum, a well-vascularized pedicle is created whenever possible and brought into the pelvis to reduce the risk of postoperative herniation through the pelvic defect. Then, the robot is undocked and the perineal phase of the procedure is commenced with the patient in the lithotomy position, with the lower limbs in stirrups and the buttocks centimeters off the edge of the operating table. The anus is usually sutured to limit contamination and favoring traction of the future specimen. An elliptical incision is created circumferentially around the anus to include the entire sphincter complex, and possibly extended in a specific direction to ensure adequate circumferential margins if any residual disease exists around the anal canal. The ischiorectal space is progressively dissected on both sides before proceeding with posterior and anterior dissection. Posteriorly, just above the coccyx, the anococcygeal ligament is divided to join the plane of abdominal dissection. At this point, usually after accurate digital exploration, the levator muscle is divided circumferentially until the specimen is released completely except for its anterior attachments. During this phase, according to tumor site and extent, we advocate a "selective extra-elevator (cylindrical) dissection" where needed, to ensure adequate circumferential surgical margins. The proximal end of the specimen is inverted and pulled out of the perineum, leaving it anchored only by its anterior attachments. With adequate traction and gentle exposure provided by the assistant, the specimen is entirely excised with sharp dissection. Direct assistance by gentle digital palpation of the rectovaginal or rectourethral septum is usually helpful to supervise the appropriate plane of division. The perineal wound is generously irrigated with saline. Careful perineal closure is crucial, as wound-related complications are responsible for most of the postoperative morbidity following robotic APR. A layer-by-layer reapproximation is the preferred method of closure, with the aim of minimizing the residual dead space. Finally, the descending colon is exteriorized in the left flank, usually utilizing the R5 port incision. Port incisions are closed in a conventional fashion and the end colostomy is eventually matured.

Patients can be started on clear liquids on the same day of surgery and advanced to a solid diet as tolerated. Urinary catheter and surgical drains are usually removed on postoperative day 2 and the patients typically discharged home between postoperative day 4 and 5.

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