Single-Incision Laparoscopic Approaches to Colorectal Disease

22

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Key Points

- Single-incision laparoscopy is safe and feasible in major colorectal surgery.
- The learning curve is quite short and almost nonexistent for those already skilled in conventional laparoscopic surgery and, more specifically, right hemicolectomy.
- Using different length instruments and a 30-degree 5-mm camera will aid in avoiding extracorporeal instrumentation collisions.
- A right-angled light cord adapter is a must.
- Do not sacrifice safety and adequacy of an operation for a limited approach.

Introduction

New surgical techniques are constantly being developed around the world. Yet, some interventions never gain traction, while others become an important part of a surgeon's skill set. Single-port laparoscopy is one approach that has steadily gained popularity across various surgical disciplines, including colorectal surgery, and is a frequent topic of discussion and investigation. It would appear that single-port laparoscopy will remain a part of surgical therapy for some time.

As the field of single-port laparoscopy grows, the trend in publications changes with it. To date, there have been a number of studies within the general, urologic, and gynecologic surgery literature looking at the feasibility and safety of the single-port laparoscopic approach to various operations [1–7]. Although the technique may vary, it would appear that nearly any surgery that can be done laparoscopically can also be done using a single-port approach [8].

Colon and rectal surgery is no stranger to this trend and in recent years has seen a vast increase in publications about the use of single-port laparoscopy [9, 10]. Our group has published the largest series of single-port laparoscopic right hemicolectomies to date and has since had a growing experience with more complex procedures using a single-port approach [11].

It is important to keep in mind that when learning any new procedure, there is a learning curve that each person must complete in order to become proficient. Single-port surgery is no different. Although the steps of a colectomy may be well engrained and the point of achieving competency using a laparoscopic approach is long past, bringing in the single-port dimension adds a degree of difficulty to the mix. There has been some data addressing the learning curve for single-port laparoscopy [12–14]. However, there have been no specific studies examining the learning curve for performing single-port laparoscopic colorectal procedures, specifically. In this chapter we will address the technical aspects of single-port surgery for various colorectal operations and highlight tips to hopefully make this approach much easier, no matter where you are on your learning curve.

Indications

Laparoscopic surgery has been shown to have multiple advantages when compared to open surgery: decreased morbidity, decreased pain, faster recovery, and shorter hospital stay [15, 16], as well as equivalent oncological results seen in the COST and MRC CLASICC trial [17–20]. Single-incision laparoscopic surgery (SILS) uses only one incision in the abdominal wall, allowing all operative work to be done in the same opening, but this does not change the fundamental tenants of laparoscopic surgery: proper exposure, triangulation, and the use of instruments and devices tailored for in-line viewing.

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During the past years, numerous reports of SILS procedures have been published showing the feasibility of this approach for even complex colon and rectal procedures [10]. To date, all types of colorectal procedures have been performed through single-port laparoscopy, from a minimally invasive stoma to a total proctocolectomy and ileoanal pouch. It is not a result of a "landmark" randomized, prospective study but rather through experience that single-site outcomes have been shown to be equivalent to multiple-site laparoscopy and open laparotomy from all perspectives. In many cases, this approach has become the preferred technique for surgeons.

The most common single-site procedures will be reviewed here, including right colectomy, sigmoid colectomy, and total abdominal proctocolectomy with J pouch.

Preoperative Planning

Whether you are performing a procedure through an open, laparoscopic or single-incision laparoscopic approach, a good history and physical examination is mandatory. In addition, appropriate patients should have a complete blood count, chemistry, and carcinoembryonic antigen (CEA) levels as indicated by their comorbidities and disease process. Additional assessment for staging and localization of a tumor includes CT scan and colonoscopy to confirm the exact location and mark the lesion with India ink. While still controversial, a bowel preparation typically follows the preference of the individual institution and surgeon. In my institution, we do not routinely prescribe bowel prep for right colectomies and use oral laxative for the other colectomies. Also, intravenous antibiotics are used perioperatively for all patients.

Appropriate patient selection cannot be overemphasized. During my initial experience, I selected patients with a low body mass index (BMI). In addition, I avoided patients with previous surgeries, due to the time-consuming lysis of adhesions, as well as patients with large tumors that can be difficult to handle.

As my experience has grown, I now use single-incision laparoscopy for all my right colectomies as well as those undergoing a total abdominal colectomy with J pouch. Regarding BMI or previous surgery, I perform single-site laparoscopic resection in selective cases for sigmoid and left colectomy when the cosmetic results are important to the patient.

Single-Incision Port Types and Port Placement

Multiple access devices have been developed and are constantly changing in an attempt to improve this developing technique of minimally invasive single-port surgery. Among them is the recent addition of a robotic single-port platform. At present, the most popular are the following six systems including:

1. The platform most commonly used is the SILS port (Covidien, Inc. Norwalk, CT), which is made from an elastic polymer. It is hourglass-shaped and can be deployed through a 2-cm fascial incision. It contains four openings: one for insufflation via a right-angled tube and three that can accommodate trocars 5–15 mm in size.
2. The GelPOINT® (Applied Medical, Rancho Santa Margarita, CA) port uses a wound protector that is also very helpful for retraction, accommodating multiple trocars 5–12 mm. This platform allows for laparoscopic surgery by providing a flexible, airtight position for multiple trocars and multiple positions that allows an easy triangulation and less collision. It's large enough to allow bowel exteriorization for extracorporeal resection and anastomosis using standard instrumentation. By offering an increased range of motion and maximum retraction and exposure, the GelPOINT platform provides the utmost versatility and access for a wide range of abdominal and transanal procedures.
3. The TriPort® (Advanced Surgical, Co. Wicklow, Ireland) has three channels, allowing up to one 12-mm and two 5-mm instruments.
4. The QuadPort (Advanced Surgical) has four lumens, permitting up to one 15-mm, two 10-mm, and one 5-mm instruments.
5. The Uni-X single-port laparoscopic device (Pnavel Systems Morganville, NJ) is a system designed to allow the simultaneous use of three 5-mm laparoscopic instruments through a single fascial incision. It requires fascial fixation sutures and curved laparoscopic instruments. The Uni-X system seems to be used primarily in urology procedures [4, 21–23]. Initial technical notes are provided by Remzi et al. [10].
6. Ethicon Endo-Surgery SSL Access System (Ethicon, Cincinnati, OH) consists of two 5-mm seals and a larger 15-mm seal in a low-profile design. Unique to the device is the 360-degree rotation of the seal cap that enables quick reorientation of instruments during procedures and reduces the need for instrument exchanges.

Right Hemicolectomy (Video 22.1)

Operative Technique

After anesthesia is induced, a Foley catheter and orogastric tube are placed. Then the patient is positioned supine on the table; the left arm is padded and tucked. Some kind of restraint device (beanbag or chest and leg straps) needs to be used to prevent the patient from falling from the table during position manipulation.

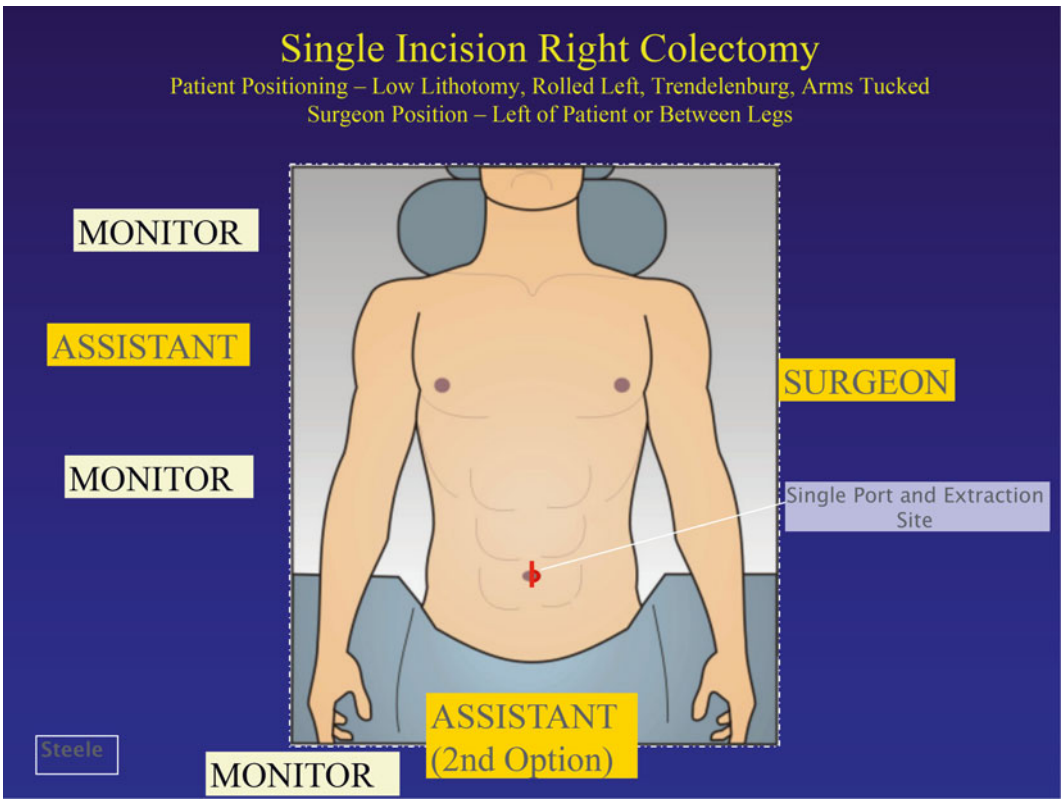

Fig. 22.1 Port placement for single-incision right colectomy. Note the left colectomy can be in the umbilicus or in the Pfannenstiel position

The patient is prepped and draped in standard fashion. The surgeon and assistants are located on the left side of the patient. Visual monitors, as many as are needed, are positioned on the opposite side of the surgeon, which allows comfort and good visualization (Fig. 22.1).

The operative technique starts with placement of the SILS™ port device placed in the umbilicus using an open technique. This provides an added degree of safety against inadvertent intra-abdominal injury [24], as well as a cosmetic benefit by hiding the future scar. A vertical incision is made in the fascia large enough to accommodate the single-port trocar (~2 to 3 cm; Fig. 22.2). A fascial opening bigger than the device will cause loss of insufflation during extreme movement of the instrumentation and can add time and frustration to the procedure and the surgeon.

Our preference is to use standard laparoscopic instrumentation (i.e., straight) including the scope. This decreases the learning curve and allows the surgeon to perform the procedure with tools to which they are accustomed (Video 22.2). A standard 5-mm 30° laparoscope of bariatric length is then inserted (or rarely a 30° 10-mm laparoscope), followed by two 5-mm working ports with non-articulating instruments: (1) atraumatic bowel grasper and (2) an energy device with multifunctional capability such as the ENSEAL® (Ethicon Endo-Surgery, Inc, Cincinnati, OH) (Fig. 22.3).

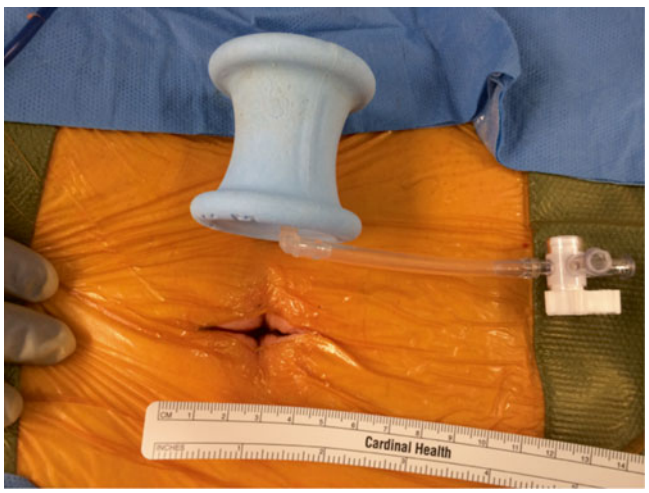

Fig. 22.2 Single-port and umbilical incision. Notice the small incision to accommodate the port to reduce air leaks

I prefer to orient the trocar with the gas port aimed toward the patient's feet, helping to keep triangulation on the 5-mm port, as well as using the top of the triangle for the camera port (Fig. 22.4).

The abdominal cavity is explored for adhesions, and most importantly when performing the surgery for colon

cancer, the peritoneum and liver must be inspected for metastatic disease. The patient is then positioned in Trendelenburg position and left side down. The omentum is grasped and placed on top of the transverse colon. My common approach is to begin medial-to-lateral dissection where the vascular pedicle is ligated before the mobilization of the colon or the tumor. I prefer to maintain the "no touch" technique and adhere to standard oncological principles [25] with gentle traction on the cecum. The ileocolic pedicle is then elevated; the small bowel is positioned on the left side of the abdominal cavity, allowing visualization of the base of the mesentery. The peritoneum underlying the ileocolic pedicle and the base of the mesentery are opened (Fig. 22.5) using laparoscopic scissors or an energy device of the surgeon's preference in order to dissect the colon off its retroperitoneal attachments and the duodenum in a medial-to-lateral fashion. Careful retroperitoneal dissection continues until the duodenum is completely identified and the head of the pancreas is seen. Once this is complete, a mesenteric window is created and the ileocolic vessels are divided using an energy device.

After the division of the vascular pedicle, this space is developed in cephalad direction, above the duodenum, between the first portion of the duodenum and the transverse mesocolon. Identification of the right branch of the middle colic vein and artery must happen while dissecting at the origin (Fig. 22.6). Then this can be ligated using an energy device. The mesenteric of the transverse colon is then divided to encircle a distal portion of the colon for the creation of the ileocolic anastomosis. The patient is then positioned into reverse Trendelenburg; the omentum is grasped and divided to be included in the en bloc resection from its attachments to the transverse colon. Next, the hepatic flexure and the lateral attachments are taken down from superior to inferior (Fig. 22.7). Careful dissection should be used when approaching the lateral attachment in the right lower quadrant to minimize the risk of ureteral injury. After confirming the completed mobilization and division of the mesentery of the terminal ileum, the cecum is grasped with a locking instrument to help during extraction (Fig. 22.8). The fascial incisions are enlarged as necessary to exteriorize the specimen for division and anastomosis. The use of a wound protector is recommended to prevent contamination of the wound, tumor seeding, and helping with the exposure. The colon is then exteriorized, ensuring you maintain proper orientation of the specimen (Fig. 22.9). The previously selected area of the transverse colon and the terminal ileum is divided and the anastomosis is created according to surgeon's preference in either side-to-side or end-to-side fashion with staplers.

After inspecting the anastomosis intracorporeally, I do not routinely close the mesenteric defect. Then the fascia is

Fig. 22.3 Instruments: 30-degree camera, energy device, bariatric length, and atraumatic bowel grasper. Different lengths will help decrease the extracorporeal collision

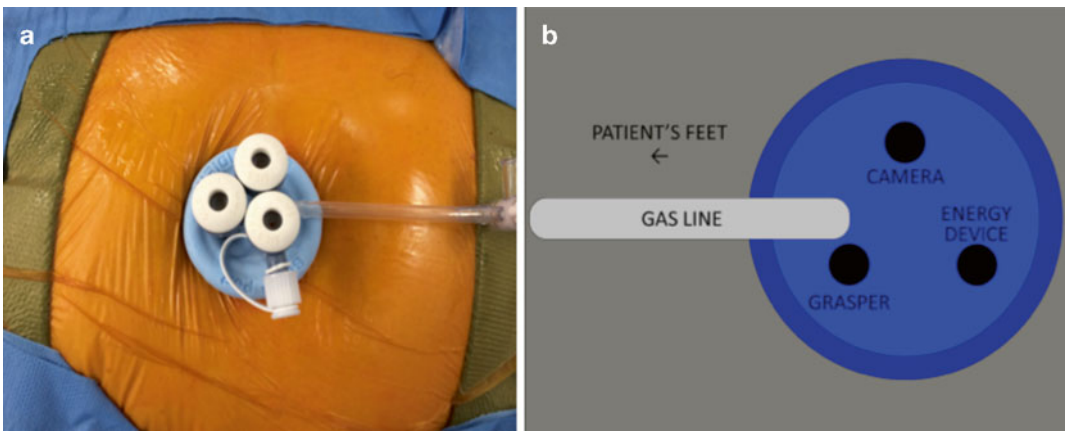

Fig. 22.4 (**a**) A vertical incision is made in the fascia large enough to accommodate the single-port trocar even in obese patients. (**b**) Diagram indicating the orientation of the port to allow triangulation of the instruments with the gas line port toward the patient's feet

Fig. 22.5 The ileocolic pedicle is elevated to allow tension to help open the peritoneum underlying the ileocolic pedicle. This is extended to the base of the mesentery

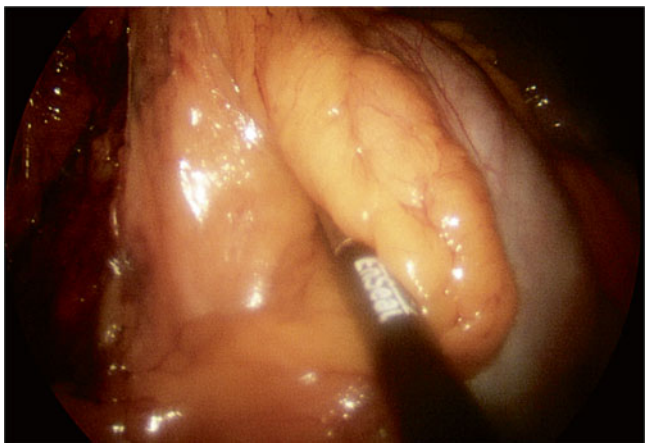

Fig. 22.6 Right branch of the middle colic artery and vein. Notice that division of the ileocolic pedicle decreases the visualization of the duodenum

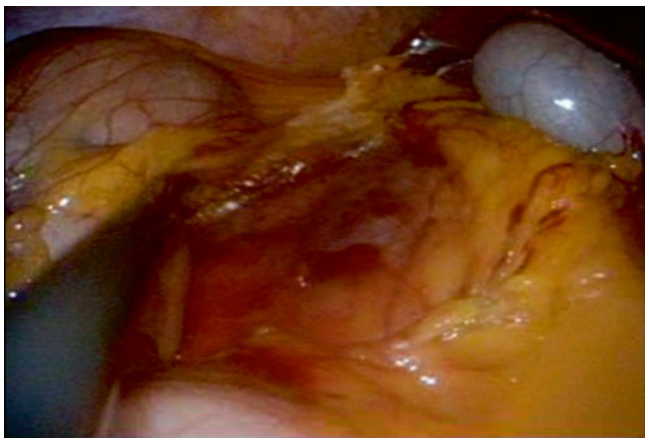

Fig. 22.7 Takedown of hepatic flexure and the lateral attachments in a superior-to-inferior fashion

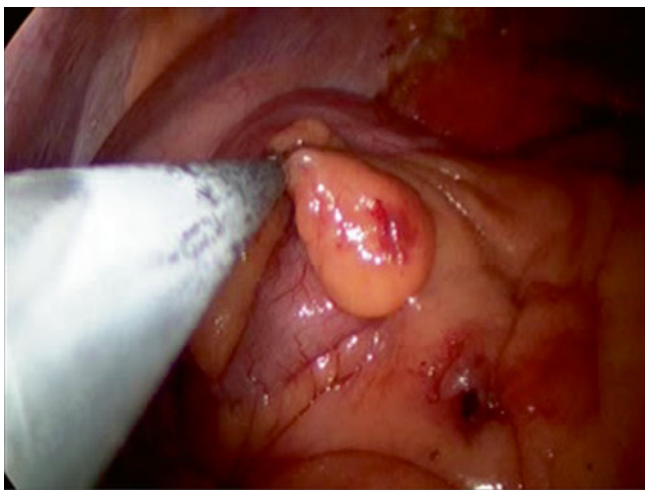

Fig. 22.8 After complete mobilization and division of the mesentery of the ileum, the cecum is grasped with a locking instrument to help during extraction

closed in either a running or figure-of-eight fashion (Fig. 22.10).

Single-Port Left Colectomy

The indications for the SILS left colectomy are the same as the open colectomy or laparoscopy. Advantages of the SILS approach depend on the surgeon's experience and the search for alternative operative techniques as well as better cosmetic and highest patient satisfaction results [26–28]. Similar to a right colectomy, there is not an absolute contraindication for the use of single-port laparoscopy, as long as procedure meets the safe surgery criteria. Also, if needed, an additional trocar can be added for camera access or retraction.

Surgical Procedure

The patient's preoperative evaluation is the same as previously described in this chapter including mechanical bowel preparation and intravenous pre-op antibiotics. After induction of the anesthesia, the patient is placed in lithotomy position with arms tucked to the sides and protected. Special attention is focused to secure the patient to the anesthesia table to prevent falling or moving during extreme table position changes. The routine use of the left ureteral stent for left colectomy may prevent any injury [29], though more likely may allow recognition of any intraoperative injury, as well as early identification of the ureter itself to help expedite the procedure.

Fig. 22.9 Extraction of the colon with a cecal tumor through the wound protector. Notice the ileocolic pedicle seen at the tip of the instrument

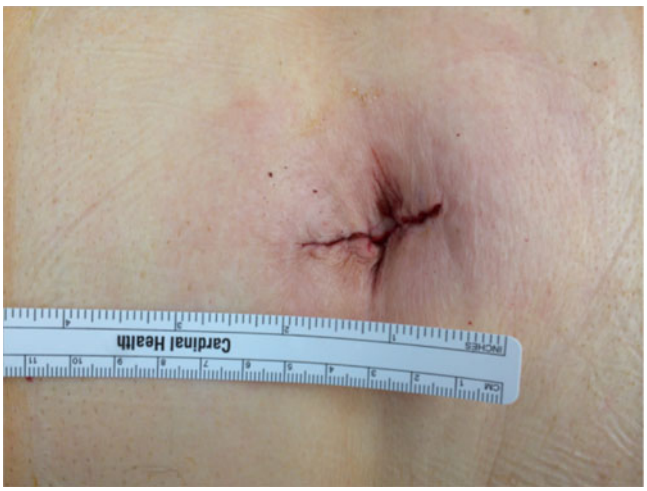

Fig. 22.10 Final incision after single-incision right colectomy

Port at the Umbilicus

The surgeon and the operative assistant are positioned on the right side of the patient if the single-port trocar is placed in the umbilicus. The surgeon may also need to stand between the legs of the patient and the assistant on the right of the patient when the alternative port placement of a suprapubic location is used. This suprapubic port site hides the scar and can also be used for colon specimen extraction. The suprapubic location is also over the rectal-sigmoid junction, allowing for direct vision, division of the rectum, and performing the anastomosis.

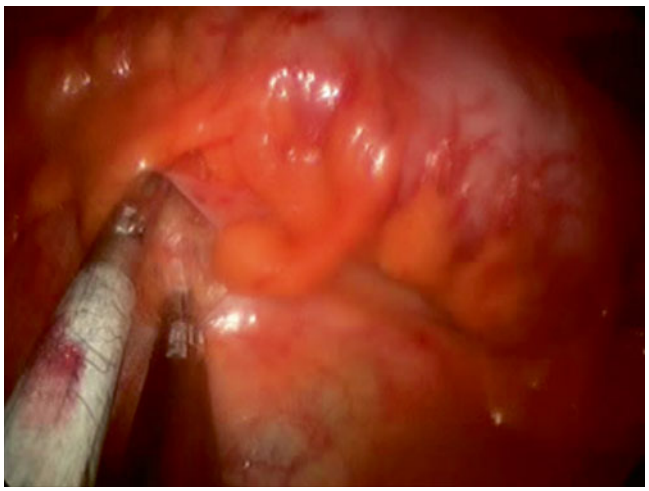

Fig. 22.11 The peritoneum is opened between the inferior mesenteric vein and inferior mesenteric artery; the longer the incision, the better the exposure of the retroperitoneum will be

An open technique is used to make a 3-cm abdominal wall incision to accommodate the SILS port. After entering the peritoneal cavity and achieving adequate insufflation, exploration of the abdominal cavity for adhesions and metastatic disease should be performed if colon cancer is a preoperative diagnosis. If the indication is cancer, then specific identification of the location of the tumor should be the next step. Ideally a previous, preoperative colonoscopy with intraluminal colon marking with ink identifies anatomic location or, if necessary, intraoperative colonoscopy with CO_2 to ensure the location. Both colonoscopy techniques are superior to intraoperative manual palpation with instruments.

The patient is positioned in Trendelenburg, and the right side of table is lower than the left. This uses gravity retraction to position the bowel on the right side of the abdomen. Placement of the omentum on top/caudal to the transverse colon allows for identification of the transverse colon and localization of the middle colic vessels and the inferior mesenteric vein (IMV) at the level of the ligament of Treitz. After scoring the mesentery along the medial aspect of the left colon from the inferior mesenteric artery (IMA) to the IMV, the surgeon may use a medial-to-lateral dissection approach with ureteral stents in place.

Surgeons may alternate between the next two steps. First, with the SILS trocar in the umbilicus, the area between the IMV and IMA can be easily accessed using a monopolar scissor. The peritoneum is opened; the longer the incision, the better the exposure of the retroperitoneum (Fig. 22.11). The retroperitoneal dissection is started under the descending mesocolon, which helps retraction by elevating the mesocolon with a sweeping movement up and down. This allows the embryological plane to be identified and bluntly separated. This dissection should be bloodless (Fig. 22.12 a,b).

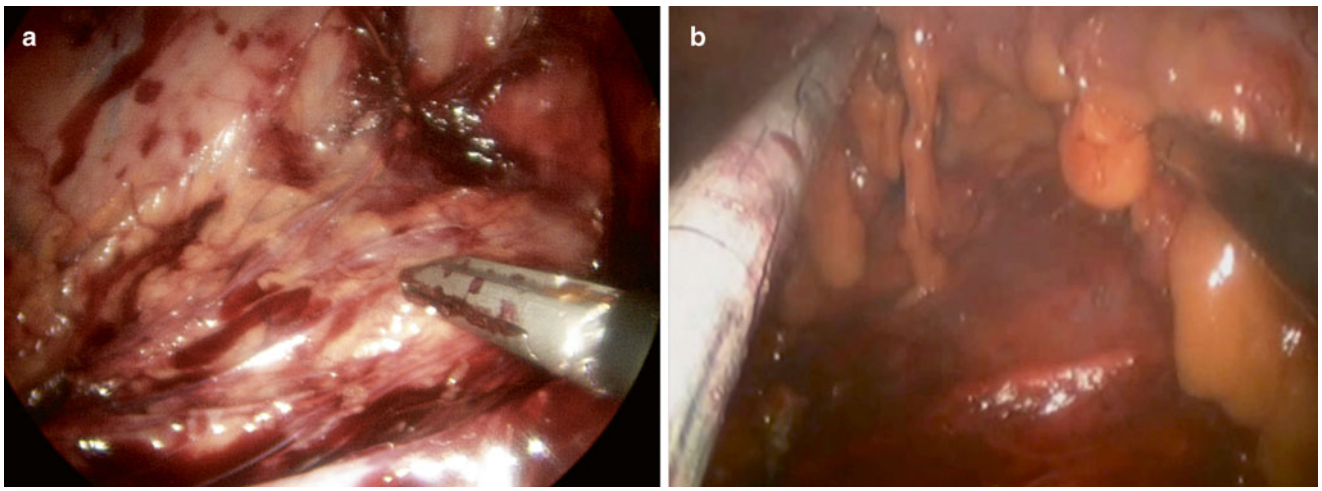

Fig. 22.12 Retroperitoneal dissection. Notice the elevation of the mesocolon with left arm and bloodless plane (**a**) before IMA division and (**b**) after IMA division

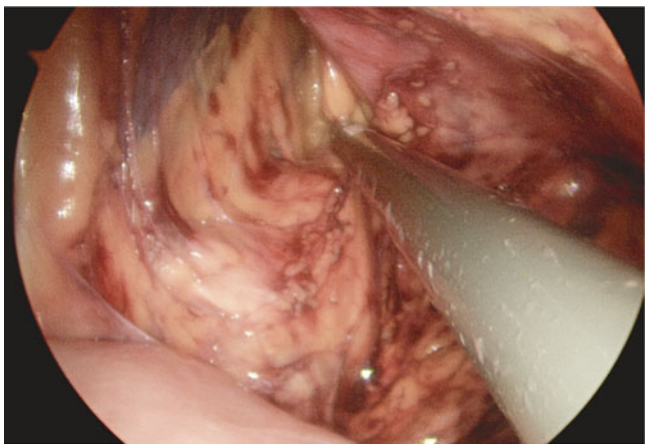

Fig. 22.13 Retroperitoneal dissection without division of the inferior mesenteric vein. This dissection is lateral and superior, with identification of the inferior border of the pancreas

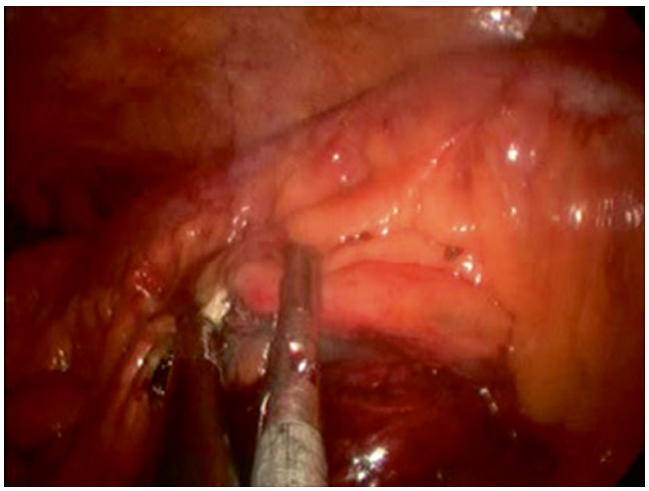

Fig. 22.14 Division of the IMA using an energy device. Notice the in-line view and the triangulation with the crossover instruments

With elevation of the IMV and continued dissection of the retroperitoneum above Gerota's fascia, you need to identify the inferior border of the pancreas. Dissection continues all the way to the lateral colon attachments with hand-over-hand instrument exchanges (Fig. 22.13).

Caudal dissection is continued to visually encircle the IMA and identify the left ureter. Once this is performed, the dissection space around the IMA exposes the origin of the artery and sweeps the nerves around the IMA-aorta junction to prevent injury to the sympathetic and parasympathetic nerve plexus. Division of the IMA can be done according to the surgeon's preference using an energy device, stapler, or clip ligation (Fig. 22.14). Dissecting the IMV without division facilitates the medial dissection of the splenic flexure and the lesser sac. Early division of the IMV will allow the heavy, floppy mesentery to fall on top of the camera and often create the need for an extra instrument to retract the mesentery. The extended dissection of the retroperitoneum will make the dissection on the lateral left colon attachments easier.

The next step involves opening the avascular area on top of the pancreas to enter the lesser sac. Identification of the posterior wall of the stomach helps confirm the correct location (Fig. 22.15). Continued use of the energy device helps to divide the colon mesenteric attachments to the inferior border of the pancreas until the left lateral attachment to the abdominal wall is reached.

Attention is now turned to the lateral attachments of the colon, starting with gentle retraction of the sigmoid medially. This will expose the lateral attachments at the level of the pelvic brim (Fig. 22.16a,b). Using the monopolar scissors will facilitate this step. After an opening is created in the

lateral attachment, visual identification of the left ureter is easy. The left-hand instrument is used to keep the lateral attachment window open, and continued division of the attachments in a cephalad (toward the splenic flexure) direction will mobilize the entire left colon (Fig. 22.17). The left lateral dissection meets the previous medial dissection at the splenic flexure.

Suprapubic Location of the Port

With the single access port in the suprapubic area, through a Pfannenstiel incision, the initial exploration is the same as described earlier, even with the view somewhat different from caudal to cephalic. The patient is rotated right side down to allow the small bowel to be placed in the right upper quadrant. The sigmoid colon or the descending colon is elevated with the left-hand instrument, an atraumatic grasper (bariatric length), exposing the superior hemorrhoidal artery at the level of the sacrum promontory. A long incision is made in the peritoneum, medial and below the artery exposing the retroperitoneum. The sigmoid mesentery is elevated and the dissection in the retroperitoneum is carried caudal to cephalic. The left ureter is recognized and dissection continues on top to the ureter and lateral as long as possible without division of the IMA.

After identification of the left ureter, the IMA is encircled around the junction with the aorta. Exposure is created by elevating the sigmoid mesentery and dissection is continued to the medial aspect between the IMA and IMV. The artery can be ligated according to the surgeon's preference: energy device, ligation, or stapler.

After ligation of the IMA, grasping the artery pedicle helps in the retroperitoneal dissection by continuing cephalad until identification of the inferior border of the pancreas and the IMV. Lateral dissection is carried as much as possible to facilitate the lateral mobilization later. Careful attention should be made to keep the ureter down in the retroperitoneum and the dissection kept between Gerota's fascia and the mesentery of the descending colon.

After identification of the inferior border of the pancreas, the IMV should be isolated. This can be accomplished with traction at the level of the ligament of Treitz. The division of the IMV with an energy device should be accomplished to avoid tension. Recognize that it can become a source of quick and massive bleeding and difficult to control during single-port surgery. Do not hesitate to place an additional port if needed to control this.

The medial dissection should be completed by this point. Attention is now turned to the lateral attachments starting with gentle medial retraction of the sigmoid colon. This will expose the lateral attachments at the level of the pelvic brim (Fig. 22.16). Using the monopolar scissors facilitates this

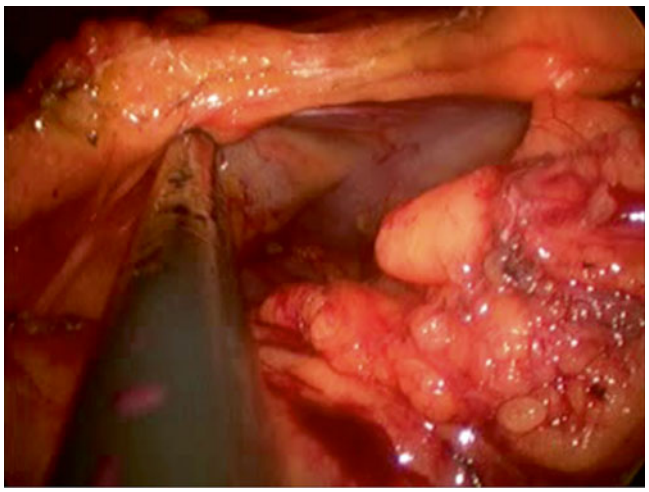

Fig. 22.15 Opening the avascular area on top of the pancreas to enter the lesser sac. Identification of the posterior wall of the stomach helps confirm the location

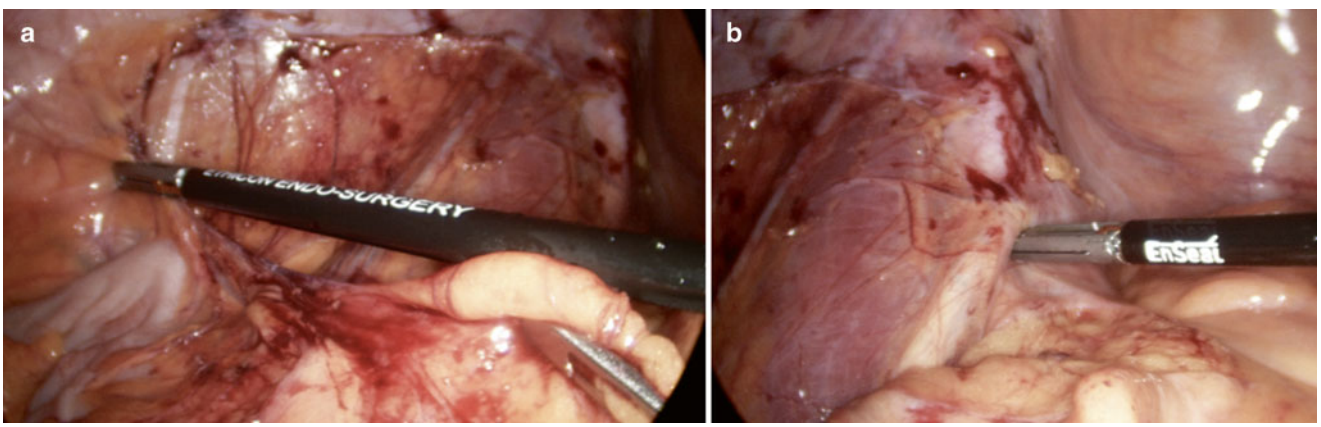

Fig. 22.16 Takedown of the lateral attachments starting at the pelvic brim. Notice the in-line instruments. (**a**) The retroperitoneum with gonadal vein. (**b**) Tip of the instrument points at the left ureter

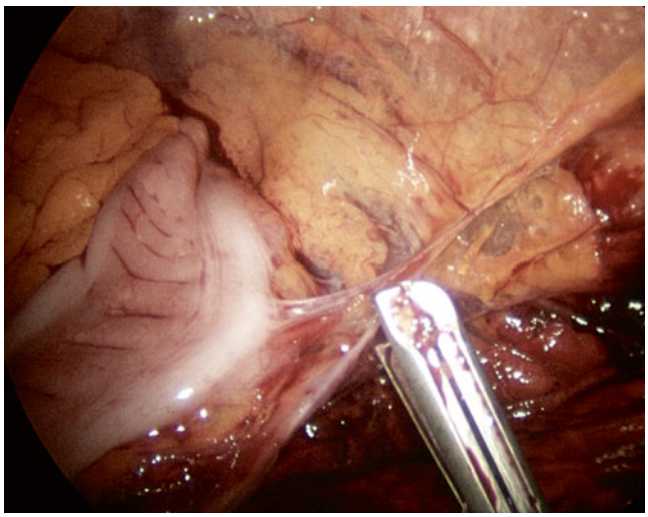

Fig. 22.17 Division of the left lateral colonic attachments (white line of Toldt)

step. After an opening is created in the lateral attachments, visual identification of the left ureter is easy. The left-hand instrument is used to keep the lateral attachment window open, and the right instrument continues division of the remaining lateral attachments along the white line of Toldt cephalad until the entire left colon is mobilized (Fig. 22.17) at the splenic flexure.

My preference is to take down the colonic splenic ligament using the ENSEAL® energy device. The lesser sac is entered laterally and the inferior border of the pancreas is identified. The patient is now placed in reverse Trendelenburg to allow better exposure of the omental attachments to the transverse colon. Elevation of the omentum with the left-hand instrument provides traction, and by using the energy device, the gravity will keep the colon away (i.e., countertraction).

You should continue to separate the omentum until the middle transverse colon or the falciform ligament is reached. At this point, all of the colon should be retracted to the right side of the abdomen to complete exposure and allow dissection of the retroperitoneum. Dividing the peritoneal attachments at the splenic flexure will allow entry to the lesser sac. With continued dissection from the left side, all attachments between the transverse colon and the inferior border of the pancreas are serially divided until the midline and the stump of the IMV are visualized.

The colon is then returned to normal anatomical position, and the patient is returned to deep Trendelenburg. A 12-mm trocar is placed through the SILS trocar to be able to place an endostapler, and the distal colon rectal juncture is divided. Alternatively, this can be done through the wound when in the suprapubic incision (although exposure through a small fascial opening is limited). The colon is exteriorized through the incision after careful placement of a wound retractor Alexis® wound protector, which will facilitate the extraction. The proximal area of the colon then is selected, and the mesentery of the colon is divided between clamps or using the energy device.

The colorectal intracorporeal anastomosis is created by first securing the circular anvil in the proximal colon and then returning the bowel into the abdomen. The single-port trocar is replaced in the incision. If the incision was enlarged to accommodate the specimen, the fascia can be approximated with a simple suture in each corner or as many as are needed to ensure an appropriate seal. If the wound protector is kept in place, a wet lap can be used to keep the airtight seal. Insufflation is obtained and the circular stapler is placed through the anal canal after dilatation of the anal sphincter. The spike is opened just inferior to the previous rectal stapler line, which will help if any anastomotic defect or air leak occurs, as the defect will potentially be anterior and is easier to visualize and repair. After the anvil and the spike of the stapler meet, the stapler is closed, inspected, and fired. The stapler is removed and the anastomosis doughnuts are checked. An air-leak test is performed using a flexible sigmoidoscopy. Compression of the proximal colon is performed while the pelvis is filled with fluid, submerging the anastomosis, and the sigmoidoscope is advanced to the anastomosis. This final inspection is performed to ensure that the anastomosis is airtight. The abdomen is aspirated dry, and the small bowel is evaluated and should be on top to the cutting edge of the colon mesentery to prevent internal hernias; then the trocar is removed, and the incision is closed.

Single-Port Laparoscopic Total Proctocolectomy with Ileal Pouch Anal Anastomosis Reconstruction Using Standard Laparoscopic Instrumentation (Video 22.3)

Single-port laparoscopic operations have recently gained attention and may extend and expand beyond the benefits of conventional multiport laparoscopy [26–28]. The cosmetic benefit has been fairly straightforward to appreciate; however, any additional benefits, such as decreased hospital stay, morbidity, or cost, to the patient have yet to be confirmed in large randomized studies. In the meantime, patients with ulcerative colitis and familial adenomatous polyposis that present in early stages of life who are often very concerned about cosmetic results may seek surgeons with a desire to improve patient outcomes and satisfaction and press on to explore the potential of single-port laparoscopy in smaller series. I will describe the steps of a multi-quadrant surgery performed through a single-port laparoscopy—the total proctocolectomy with J pouch—one of the most complex operations a colon and rectal surgeon performs.

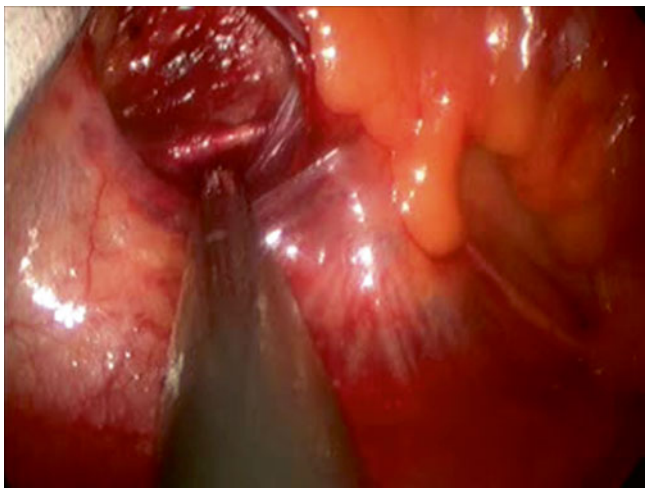

Fig. 22.18 The left ureter is recognized at the tip of the instrument

Fig. 22.19 The patient secured to the table with a 3-inch tape, in a modified lithotomy position

Preparation and Positioning

The patient should be marked appropriately by an enterostomal therapist for ileostomy placement in the right lower quadrant prior to proceeding to the operating room. Once on the operating table, the patient should be placed in a low lithotomy position using the Allen stirrups and both arms are tucked close to the patient with pads to protect for ulnar and radial nerve injuries and allow the operative team to rotate freely around the patient during the evolution of the procedure (Fig. 22.18). The patient is strapped securely using a 3-inch silk tape around the chest in order to facilitate frequent and pronounced bed movement throughout the case (Fig. 22.19). Ureteral stents are beneficial and may be placed at this time [29]. As with other colon and rectal procedures, mechanical bowel preparation before the surgery and appropriate intravenous antibiotics are given prior to the initial skin incision.

Single-port total colectomy can be accomplished by an experienced single surgeon. An assistant of any level may assist during most of the cases. The participation of the assistant can vary throughout the procedure, but at a minimum, they be facile at operating the laparoscopic camera.

The operation is performed through a SILS™ port. I use a standard laparoscopic scope, 5-mm 30-degree angle, for the duration of the case. Many surgeons find that a flexible scope is useful in some portions of the procedure, allowing the camera holder to establish a farther distance away from the surgeon; however, at the same time, it adds a level of difficulty and requires experience in the use of the device. Instrumentation includes atraumatic bowel grasper; energy device with multifunctional capability, ENSEAL® (Ethicon Endo-Surgery, Inc); endostapler 60 mm with blue reloads for bowel resection and creation of the pouch; 25- or 26-mm circular stapler for end-to-end ileoanal pouch anastomosis; and Alexis® wound retractor (Applied Medical).

Position of the Patient and Single-Port Multi-trocar Access System Placement (SILS ™)

For the right-side part of the procedure, the patient will be in reverse Trendelenburg with the left side down to allow gravity to locate the small bowel in the left side of the abdomen and facilitate in the identification of the ileocolic artery. During the transverse colon mobilization, the patient is in Trendelenburg but leveling the table; then for the left side and rectal dissection, the table will go to Trendelenburg with right side down.

The surgeon should start by making a circular incision at the ileostomy site. After dissecting down to the level of the fascia, the rectus muscle is separated and the posterior fascia is opened; an incision is made in order to accommodate the single-port access system of the surgeon's choice.

Colonic Dissection

Starting with the right colon, a window is made into the retroperitoneal space just below the ileocolic pedicle similar to the right colectomy earlier. Prior to ligating the vessels, mobilization of the colon proceeds in a medial-to-lateral fashion. Next, the lateral attachments of the right colon are taken down from superior to inferior. When mobilizing and ligating the vessels to the transverse colon, the omentum is left in place. Once ready to take down the left and sigmoid colon, the inferior

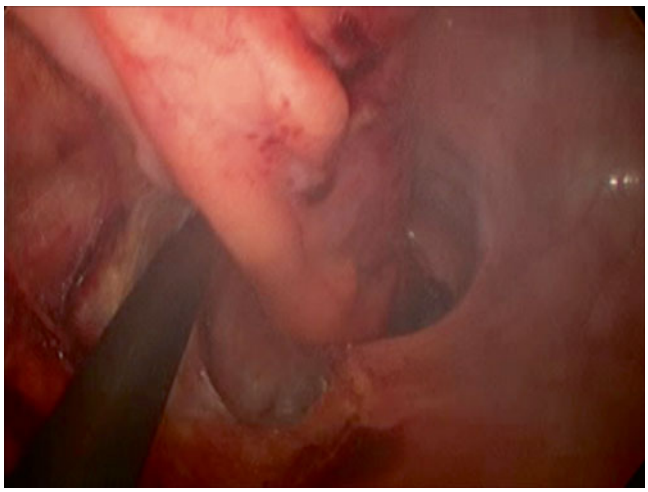

Fig. 22.20 The dissection of the rectum is carried out by staying in the planes between the layers of the fascia propria of the mesorectum and the presacral fascia

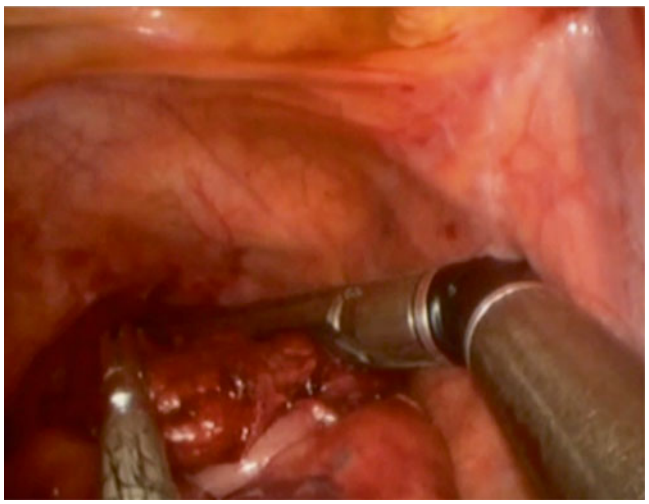

Fig. 22.21 The laparoscopic stapler is placed from the right side to the left, anterior to posterior. The key is to have good traction and using the stapler with both articulation and rotation

mesenteric artery can be ligated early to allow medial-to-lateral dissection to proceed. In this case, the lateral attachments of the left colon are easier to remove working from inferior to superior (pedal to cephalic).

Proctectomy

The rectum is often better dissected using monopolar cautery. We use endoscissors, as these are bloodless and expeditious in dissection. It is important to identify the ureters at the pelvic brim and avoid injury to the nervi erigentes. The dissection of the rectum is carried out by staying in the correct planes between the layers of the fascia propria of the mesorectum and the presacral fascia (Fig. 22.20). The posterior dissection is continued down in the midline between the rectal fascia and Waldeyer's fascia to the level of the levator ani. It's important to stay in this plane to prevent injury to the sacral venous plexus, which will result in major bleeding. One of the 5-mm ports must then be swapped out for a 12-mm port in order to accommodate a large laparoscopic articulating GIA stapler. With a laparoscopic Allis clamp, traction is performed to the left side of the rectum, and the stapler is placed in the right side of the pelvis with a maximum articulation from right to left and up to down (Fig. 22.21). The key is to have good traction and use the stapler with a rotational component. Also, the previous dissection should be all the way to the anal canal to eliminate the extra fat of the mesorectum that can make the placement of the stapler more difficult. The rectal division is completed with the fewest number of staple loads as possible—usually two. On occasion, an extra trocar in the left quadrant can be placed and used as a drain site.

Specimen Extraction

A wound protector is placed at the ileostomy site and the excised specimen is brought out. The terminal ileum can now be divided extracorporeally. The most important step in making an ileoanal pouch is to create a tension-free anastomosis. These can be difficult to evaluate during the extracorporeal formation of the pouch. To create a tension-free anastomosis, we assess the potential for the pouch to reach the anus before the pouch is created. This is done by ensuring the pouch reaches the symphysis pubis externally, and then a standard 12- to 15-cm J pouch is created using the same Endo GIA stapler. The anvil of a circular stapler is secured to the distal aspect of the pouch and then returned to the abdomen.

Ileoanal Anastomosis

We perform a double-stapled anastomosis technique. After reestablishing pneumoperitoneum, we ensure that there is no tension or torsion of the pouch. Then place the circular stapler through the anus and secure the anvil to the spike of the stapler. After firing, the anastomosis should be air-leak tested and the doughnuts checked for two complete intact rings of tissue (Fig. 22.22a–c).

Ostomy

After inspecting the abdomen a final time, a loop of ileum is selected approximately 15–20 cm proximal to the pouch in order to form a temporary loop ileostomy.

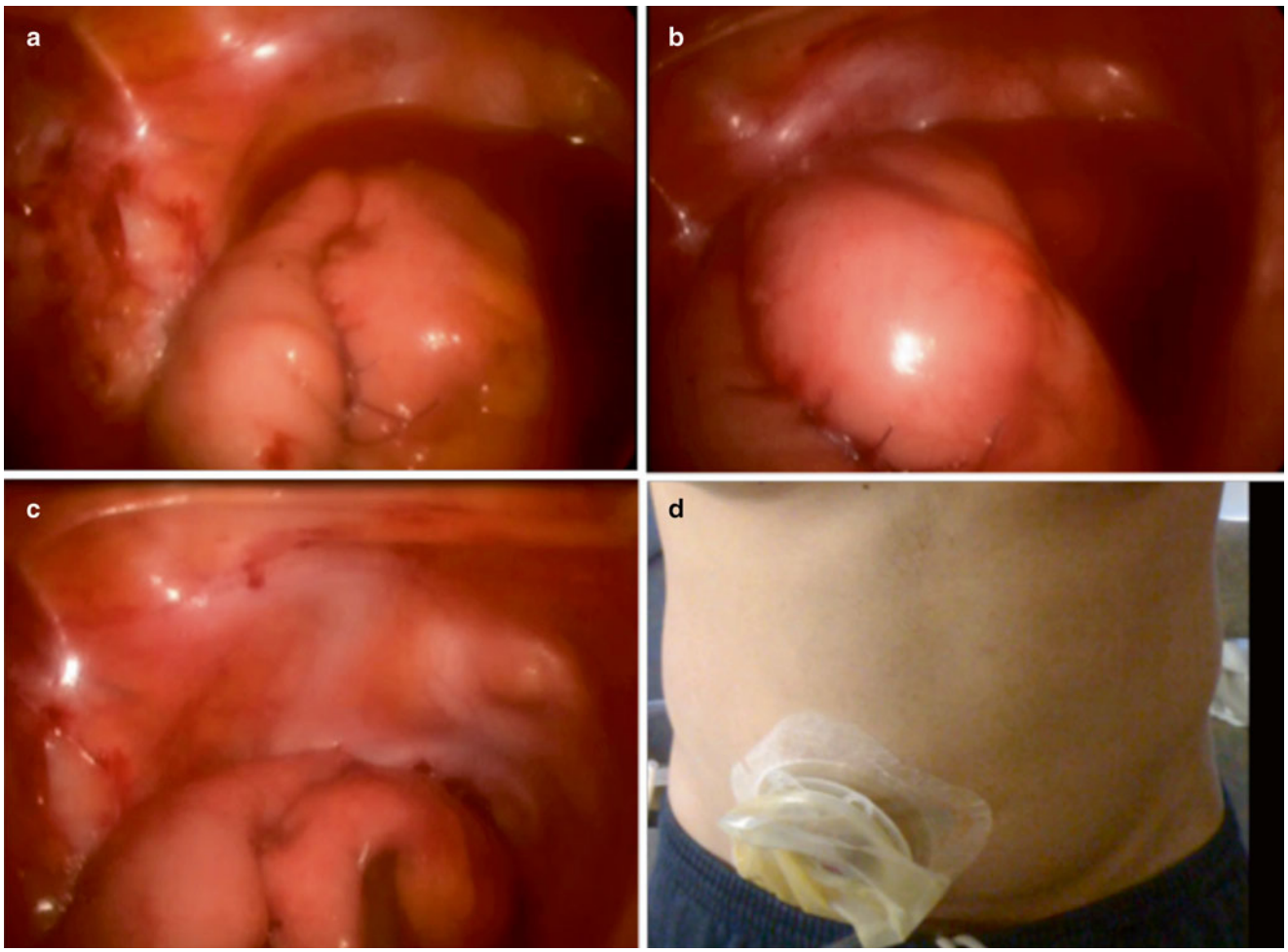

Fig. 22.22 (**a**–**d**) Pouch leak test (**a**) pouch anastomosis in place, (**b**) air in the anal canal with proctoscopy anastomosis underwater, (**c**) pouch desufflated, (**d**) postoperative day one with only the ostomy visible

This ostomy is matured in the standard fashion. No drains are placed, and the patient is left with a visible ileostomy-only incision (Fig. 22.22d).

Postoperative Care

All the patients get regional anesthesia with a transversus abdominal plane (TAP) block using bupivacaine liposome injectable suspension for postoperative pain control as well as intravenous acetaminophen. The patients are allowed to drink a clear liquid diet with a nutritional supplementation. If liquid diet is tolerated, the intravenous fluid is discontinued and they are advanced to regular diet. The Foley catheter is removed on postoperative day one in almost all the patients. When the patient is tolerating a regular diet, they are changed to oral pain medication. Once they are comfortable with the stoma, taking enough calories and liquids, and passing flatus, they may be discharged home.

Complications

In my experience, single-incision laparoscopic colectomy can be used as a safe and efficacious approach to colorectal resections in patients eligible for traditional laparoscopy with minimal additional equipment. Single-incision laparoscopy was undertaken without an increase in morbidity or mortality. All of the standard complications ranging from wound infections to abscesses may occur. Intraoperative bleeding is more difficult to control during a single-incision operation due to the lack of triangulation and space to place

the additional instrument or suction. In this case, you can use clips, Endoloops™ (Ethicon, Cincinnati, OH), or an energy device or place another trocar.

Outcomes

Among the potential advantages of single-incision laparoscopic colectomy compared with the standard laparoscopic colectomy, cosmesis is an important factor. The perspective of body image is often very important in young patients, and single-incision approaches facilitate this trait.

Postoperative pain and recovery typically show to be improved by this approach. The patients typically demonstrate a significantly lower postoperative analgesic requirement, early ambulation, and early discharge.

Pearls and Pitfalls

- Single-port laparoscopic surgery allows common laparoscopic procedures to be performed entirely through the umbilicus and permits the surgeon to convert the procedure to multiport laparoscopic surgery at any point during the operation.
- Modification of the operative technique can allow a colectomy to be performed without any additional access sites and without any minilaparotomy using the single-port access as extraction site.
- Operative time is probably longer in the single-incision laparoscopy in the beginning but will continue to decrease as additional cases are performed.
- The single-incision laparoscopic colectomy, as opposed to laparoscopic colectomy, can be harder to teach. Only one person can work at a time during a single-port laparoscopy case. It is an ergonomic challenge to get the cameraperson and the surgeon positioned so that the case can proceed.
- The division of the vessel during single incision should be accomplished with minimal tension. Recognize that it can become a source of quick and massive bleeding and difficult to control during single-port surgery.

Conclusion

Single-port laparoscopy is becoming a popular option in the field of colorectal surgery. However, because it is a relatively new approach, many surgeons do not have any formal training in performing the operations with the new instruments. Those who are taking it upon themselves to learn this new technique do not yet know the number of cases it takes to become proficient in safely performing this operation. Many surgeons have found that the learning curve is quite short and almost nonexistent for those already skilled in conventional laparoscopic surgery and, more specifically, right hemicolectomy.

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