Laparoscopic Colorectal Surgery

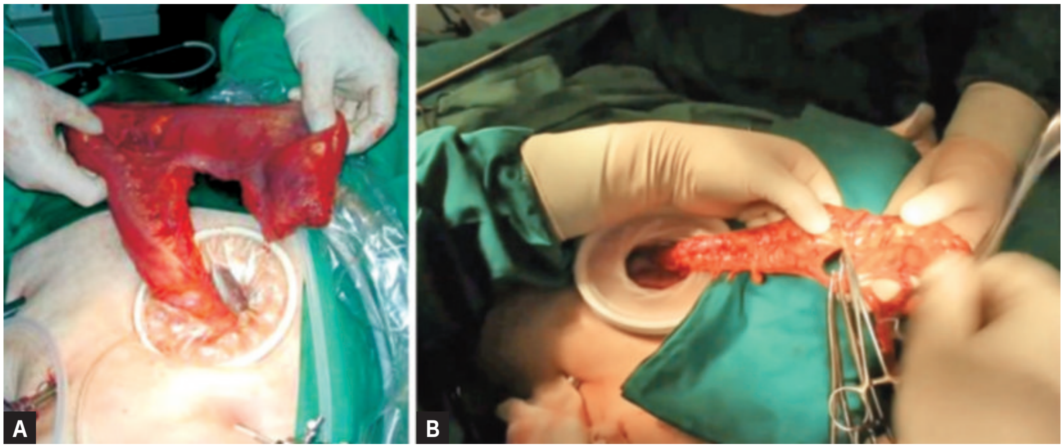
Prof. Dr. R. K. Mishra

INTRODUCTION

Laparoscopic colon resections are being performed with increasing frequency all over the world. However, the use of minimal access surgery in colorectal surgery has lagged behind its application in other surgical fields. Since the first laparoscopic colectomy was described in 1991, a great deal of controversy has surrounded its use, particularly in the management of colorectal cancer. After the successful introduction of laparoscopic colectomy by Jacobs, laparoscopic surgery for the treatment of colorectal cancer, especially laparoscopic rectal surgery, has been developed considerably. Several new important studies have demonstrated the benefits and safety of laparoscopic colorectal surgery, making it now the preferred approach in the surgical management of many colorectal diseases.

The technique of laparoscopic colectomy has a long learning curve because of the advanced laparoscopic skills it entails. Unlike other laparoscopic procedures, such as the Nissen fundoplication or cholecystectomy, colorectal procedures involve dissection and mobilization of intra-abdominal organs in multiple quadrants. *Tilting of the operating-room table in various positions during an operation uses gravity to allow intra-abdominal organs to fall away from the area of dissection*, providing necessary exposure that would normally be achieved through the use of retractors. Intestinal resection requires laparoscopic ligation of large vessels, mobilization and removal of a long floppy segment of the colon, and restoration of intestinal continuity. Once the colon segment has been thoroughly mobilized and its blood supply divided, a small skin incision is made to exteriorize the colon, then resection and anastomosis are performed extracorporeally, and the rejoined colon is placed back into the abdomen.

The laparoscopic approach continues to gain popularity and has evolved to include not just "pure" laparoscopic techniques but also hand-assist devices. Hand-assisted surgery can be used as a bridge for surgeons who are not completely familiar or facile with laparoscopic techniques, and even for the most experienced laparoscopic surgeons, it is often the preferred technique for surgery involving left-sided pathology **(Figs. 1A and B)**. The use of a hand-assist device provides tactile feedback for the surgeon and shortens operating-room time while still preserving many of the advantages of laparoscopic surgery. By combining laparoscopic surgery with the tactile feedback of a hand-assisted device, surgeons can reduce operating-room time and have a lower procedure conversion rate. The technique involves making an incision the width of a hand and placing a hand-assist device to facilitate laparoscopic dissection. New handport devices make this technique possible without loss of pneumoperitoneum, which is essential for performing laparoscopic procedures. Because an incision



Figs. 1A and B: Hand-assisted colorectal surgery.

(4–5 cm) is necessary to remove the colon specimen at the end of a laparoscopic operation, the difference between a pure laparoscopic procedure and a hand-assisted operation is generally a few additional centimeters (3–4 cm) of incision length. Several clinical trials have demonstrated that there is no difference in patient recovery or discharge for laparoscopic versus hand-assisted techniques. Larger incisions are often needed, and because of the increased risk of wound infections and pulmonary complications, this technique has particular advantages with overweight or obese patients.

Most patients are candidates for a laparoscopic approach. When the surgeon is experienced, even patients with a history of abdominal surgery can form possible candidates. Though there are clear benefits, they have not been as compelling when compared to the clear advantages associated with other laparoscopic procedures. The main reason is that a colectomy, whether open or laparoscopic, results in a delayed return of bowel function. Though recovery of bowel function is quicker after laparoscopic surgery, the difference is on the order of 1 or 2 days, resulting in a similar reduction in length of hospital stay. Also, the laparoscopic approach is associated with longer operating-room times. Even if long-term benefits are equivalent between open and laparoscopic techniques, the short-term benefits are real advantages for patients. In practical terms, the laparoscopic approach is associated with less pain, a faster recovery, earlier return of bowel function, a shorter hospital stay, possible immune benefits, and smaller scars, making it the preferred method for intestinal resection.

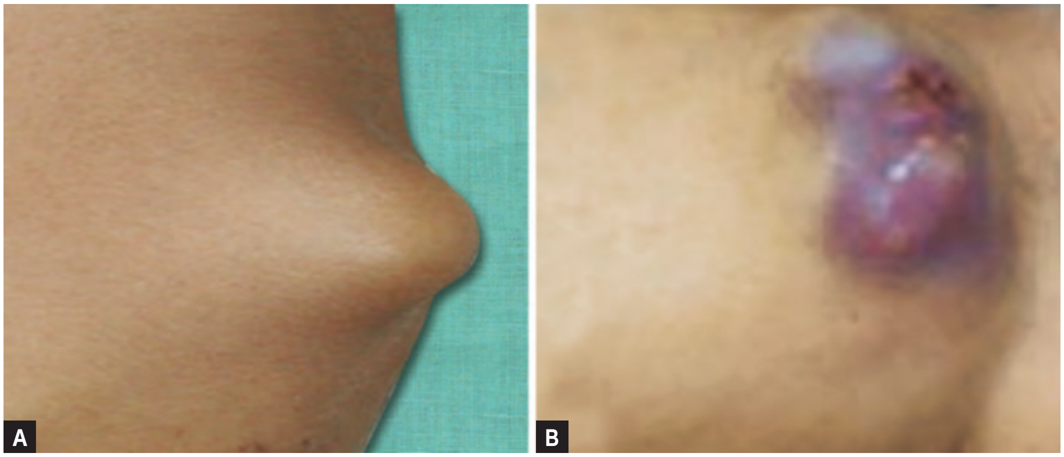
The lack of tactile feedback during laparoscopic surgery can make tumor localization difficult, especially if the lesion location has not been tattooed on the colon wall before surgery. It is imperative that the exact location of the tumor is known prior to proceed with colectomy. Even when the lesion location has been tattooed onto the colon, often the mark can be challenging to see, or there may be confusion regarding the location of the tattoo in relation to the tumor (proximal or distal), which can affect surgical margins. Intraoperative colonoscopy is a way of definitively localizing a lesion and should be available during all laparoscopic colectomies. A traditional colonoscopy uses room air as the insufflating gas, which leads to significant bowel distension and requires clamping of the proximal colon to minimize this effect. Clamping the bowel can lead to injury, and even when it is successfully performed, the degree of distension often makes simultaneous laparoscopic visualization difficult. These problems can be circumvented with the use of CO_2, rather than room air, as the insufflating gas. Because CO_2 is absorbed much more rapidly than room air, bowel distension is minimized and dissipates quickly, making proximal clamping unnecessary. The use of CO_2 allows for laparoscopic and endoscopic procedures to be performed simultaneously, and this technique has been shown to be safe and clinically useful. Besides tumor localization, CO_2 colonoscopy may have other potential applications.

PORT-SITE METASTASIS

In the early experience of laparoscopic colectomy for cancer, a few reports described immediate tumor recurrence at the laparoscopic incision sites, referred to as port site recurrences **(Figs. 2A and B)**. It was hypothesized that such early cancer recurrence happened after laparoscopy due to tumor shedding and/or accelerated tumor growth, secondary to the presence of gas in the peritoneal cavity. However, multiple reviews have indicated that this is not the case. In one such study, which included over 2,600 cases, the rate of port-site recurrence was approximately 1%, which is similar to that noted in open colorectal surgery. It is not currently believed that laparoscopic colectomy is associated with early wound recurrences.

Port-site implantation was a concern in the early period, but it has been shown now that it can be prevented by:

- Proper protection of port site while delivering the specimen. (Endobags® and pouches).
- Avoid squeezing of the specimen by taking a liberal incision.



Figs. 2A and B: Port-site metastasis after laparoscopic surgery.

- Thorough wash to the wound, 5FU solution irrigation of all ports
- Slow-release of pneumoperitoneum
- Lap-lift technique

The cost can be brought down by either doing a hand-sewn anastomosis through the specimen delivery site or use of conventional stapler for extracorporeal stapled anastomosis. Minimal use of disposable ports and instruments can further cut down the cost. The use of ultrasonic energy sources in the form of harmonic shears (Ethicon® and USSC®) has added to some of the cost of lap surgery.

The two burning issues are port-site metastasis in malignancies and cost factor due to the use of endo staplers. As mentioned earlier, for a benign condition such as rectal prolapse, adenomas, rectal polyposis, and inflammatory condition such as tuberculosis, ulcerative colitis, and simple diverticulitis, laparoscopic surgery offers a patient-friendly technique. Crohn's disease, though not very common in India, laparoscopy can be offered for the diagnosis, lymph node sampling, and curative resection. Ileocecal tuberculosis is commonly seen in our country, and it is an excellent option to provide the benefits of laparoscopy to these patients whenever surgery is indicated. Incidental colonic resection is unlikely to help the laparoscopic surgeon team in mastering the techniques. The reduction of OT time due to better coordination and cost-benefit to patients can only be offered by repetitive performances. A dedicated team effort will surely bring this specialty under the umbrella of minimal access surgery as has happened in the western world.

BOWEL PREPARATION IN COLORECTAL SURGERY

Though widely accepted as sensible and logical, it has never been subjected to any stringent scrutiny. The ideal method of mechanical preparation should be simple, inexpensive, without distress, and side effects to the patient. However, such an ideal method does not exist. It must be chosen with respect to patient acceptability, efficiency and influence on fluid and electrolyte imbalance and fecal microflora. The conventional method involves a 3-day regimen consisting of low residue and clear liquid diet combined with purgation using laxatives and enemas. Although satisfactory in bowel cleansing in about 70% of patients, it is rather exhausting due to reduced calorie intake. It is time-consuming and may result in dehydration if the patient drinks an inadequate amount of fluids. These disadvantages stimulated the development of more reliable, efficient, and quicker methods, which are given in the following text.

Elemental Diets

Low residue liquid or elemental diets were used with the intention that nutrients could be absorbed in the small intestine. Although, these results in low fecal bulk, satisfactory cleansing is obtained in only 17% of the patients. Nausea and vomiting can occur, and the evidence does not favor elemental diets as a sole means of bowel preparation.

Whole-gut Irrigation

Saline: Normal saline is instilled through a nasogastric tube at a constant rate of 50–70 mL/min in 4 hours, requiring a total of 10–14 L of fluid. Cleansing effect is achieved in 90% of the patients; however, the concentration of colonic bacteria is not reduced unless antibiotics are added. Many patients complain of abdominal distension, nausea, and vomiting. Other drawbacks of this method include the large volume of irrigants, need of nasogastric tube, risk of electrolyte disturbance and water retention, and nursing care required to assist the patient. It is contradicted in patients with gastrointestinal obstruction, perforation, and toxic colitis and has to be used with caution in patients with cardiac problems.

Castor oil: It (30–60 mL) orally achieves good cleansing but requires a large volume of magnesium citrate purgative to achieve the desired results and requires to be given 2 days before surgery followed by anal washouts a day prior which entails preoperative admissions for 3–4 days. Unpalatabilty is another drawback.

Mannitol: Mannitol is a nonabsorbable oligosaccharide which acts as an osmotic agent by pulling fluid into the bowel and producing a purgative effect by irritating the colon. Being a sugar, it is quite palatable and can be flavored by mixing it with fruit juice. Usually, 4 L of 5% solution is consumed over 4 hours, which can be difficult and can result in abdominal discomfort and nausea. To avoid these side effects, hypertonic solutions (10–20%) can be used but these predispose to dehydration and electrolyte losses. Overall, good cleansing is produced in about 80% of the patients, but leads to a high wound infection rate probably by acting as a bacterial nutrient and production of explosive gases as a result of fermentation into methane and hydrogen by anaerobic bacteria is seen. The same can be overcome by using of an antibiotic.

Polyethylene glycol (PEG): To overcome the drawbacks of mannitol, PEG (PEGLEC) in a balanced electrolyte solution was introduced which also acts as an osmotic purgative **(Fig. 3)**.

To achieve satisfactory cleansing in >90% of the patients, an average of 2–4 L of PEGLEC solution must be ingested with tea and lemon. Studies using PEG have shown a significantly lower incidence of fluid retention and lesser aerobic and anaerobic fecal bacterial counts compared to other agents. It is nowadays used as an agent of choice for preparations of the bowel before endoscopy and colonic surgery in a nonobstructed patient.

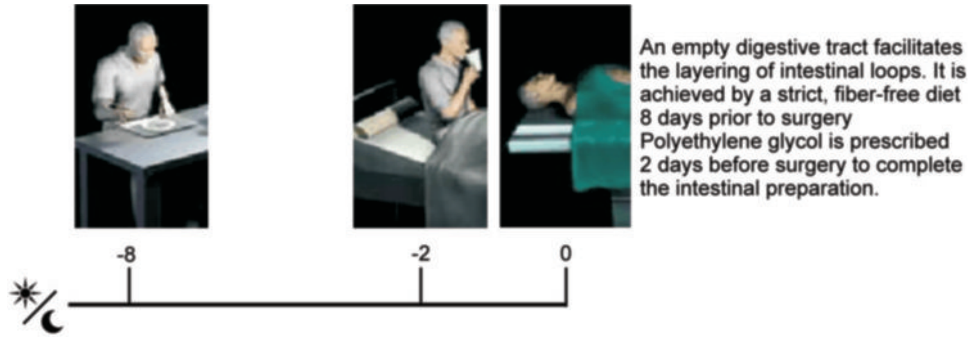


Fig. 3: Bowel preparation in colorectal surgery.

Picolax: It (sodium picosulfate and magnesium citrate) is a stimulant purgative that acts mainly on the left colon after activation by colonic bacteria and on osmotic laxative that cleanses the proximal colon. Two sachets in 2 L of water are administered with dietary restrictions to improve effectiveness. Although acceptable cleansing is achieved in 85% of patients undergoing barium enema and colonoscopy, its efficacy for elective colorectal operations is poorly documented. Picolax is well tolerated but does produces fluid and electrolyte losses.

ANTIBIOTIC BOWEL PREPARATIONS

Mechanical cleansing alone has failed to achieve a significant reduction in the total bacterial load of the colon and, therefore, the associated septic complications. Addition of antibiotics, oral as well as parenteral, to mechanical cleaning has resulted in a significant reduction of the infection rate from 30 to 60% in an uncovered patient to as low as 2–10% in otherwise patients covered with broad-spectrum antibiotics.

Oral Antibiotics

Because the aerobic *Escherichia coli* and the anaerobic *Bacteroides fragilis* are frequently involved organisms in septic complications following colorectal operations; oral antibiotics active against both types of bacteria must be given. Oral administration of erythromycin, neomycin, and metronidazole are popular. Several studies have documented the efficacy of oral antibiotics; however, an antimicrobial used alone without mechanical cleansing has little impact on the postoperative infection rate.

Parenteral Antibiotics

Since parenteral antibiotics are valid only when adequate tissue levels are present at the time of contamination, systemic administration should start immediately before the surgery. A second- or third-generation cephalosporin with metronidazole is the most commonly preferred agent. Studies had shown conflicting results when parenteral antibiotics were compared with oral or both. Whether antibiotics bowel preparation should be oral, systemic, or both are still a controversial issue. The majority of the surgeons would prefer parenteral antibiotics or with concomitant administration of oral antimicrobials together with oral PEGLEC electrolyte solution as the method of choice of preoperative bowel preparation.

Though observational data suggest that mechanical bowel preparation before colorectal surgery reduces fecal mass and bacterial count in the lumen, but the practice has been questioned because the bowel preparation liquefies feces, which could increase the risk for intraoperative spillage, and may be associated with bacterial translocation and electrolyte disturbance. Though commonly practiced without the benefit of evidence from randomized trials, and two of three meta-analyses suggest a higher rate of anastomotic leakage with mechanical bowel preparation thus calling for an end to the practice of mechanical bowel preparation in view of the possible disadvantages of this practice, patient discomfort, and the absence of clinical value. There are others who accept that though routine preoperative bowel cleansing is no longer justified prior to colorectal surgery in general, they call for further evaluation in cases such as total mesorectal resection with low anastomosis where it may still have a role and therefore to consider each case carefully, otherwise the chance of making an inappropriate decision exists with significant consequences for patients.

The majority of surgeons believe that patients should have a standard bowel preparation 48 hours before the operation and should receive a single-dose antibiotic dose immediately preoperatively. For the bowel preparation, patients follow a strictly fiber-free diet eight days before surgery and take a sodium phosphate oral solution the day before surgery. This method is very useful because it ensures an empty digestive tract and a flat small bowel, which facilitates the layering of intestinal loops, a crucial point for achieving adequate exposure. Alternatively, the PEG can be used. In this case, administration 2 days before surgery is preferable to avoid distension of small bowel loops that may be difficult to handle during the surgery.

RIGHT COLECTOMY

A right colectomy or ileocolic resection is the removal of all or part of the right colon and part of the ileum **(Fig. 4)**.

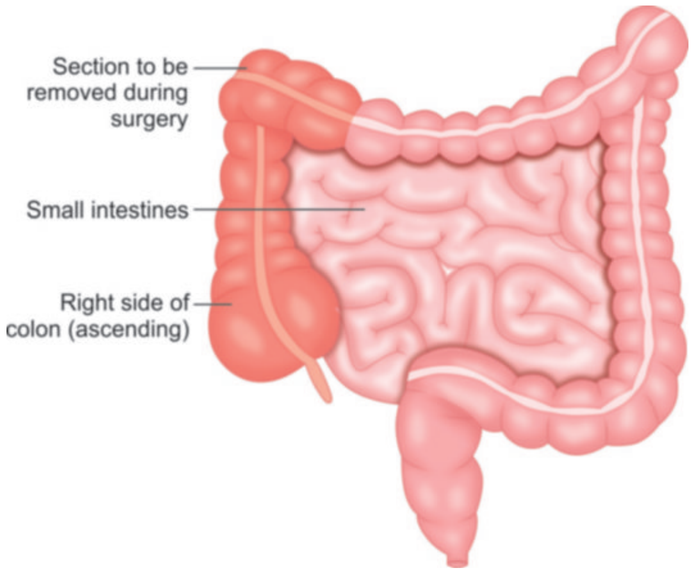


Fig. 4: Section to be removed in right colectomy.

These operations are performed for the removal of cancers, certain non-cancerous growths as well as severe Crohn's disease. If performed by an expert laparoscopic surgeon, laparoscopic right colectomy and ileocolic resection are as safe as "open" surgery in carefully selected cases.

Indications

The advanced laparoscopic skills required for laparoscopic resection of the colon and rectum have precluded wide dissemination of this procedure. By applying certain key principles, laparoscopic right hemicolectomy can be made simple, reproducible, easy to teach, easy to learn, and cost-effective. Although benign tumors not resectable by a colonoscopic procedure and structuring inflammatory bowel disease may be good indications for laparoscopy, they are not so common. The most common disease for right colectomy is right-sided colon cancer. Colon cancer seems to be a good indication for laparoscopic surgery if performed using proper oncologic methods, i.e., early proximal ligation of the major mesenteric vessels and wide mesenteric and intestinal resection with complete lymphadenectomy. For right colectomy, either laparoscopic mobilization of the bowel and/or mesenteric resection, both are performed as for open colectomy, and bowel division and creation of the anastomosis can be performed extracorporeally.

Contraindications

- Patients with complete obstruction caused by the cancer
- Cancer extensively invading adjacent organs
- Bulky cancer >10 cm in size should be excluded.

According to these concepts, a proper oncologic approach using laparoscopy for right colon cancer is described in this chapter.

Equipment and Instruments

One can use the same basic equipment, such as light source, insufflator, 30° angled laparoscope, and 5-mm graspers. To this basic equipment, can be added reusable instruments such as Babcock and alligator clamps, which should be at least 38–40 cm in length to reach from the depths of the pelvis to the upper abdomen using limited port sites. In developing countries, these reusables can be used if necessary but trying to keep disposable equipment to a minimum. Three 10 or 12 mm trocars with stability threads, plus reducers for 5-mm instruments should be used. Cannulas should allow instruments to move through smoothly while maintaining a good seal after multiple instrument passages. An energy source device of one's choice can also be added, such as bipolar, LigaSure™, or harmonic scalpel. Additional disposable equipment is kept readily available in the operating room and used only as needed. These include a clip applier, linear vascular stapler, suction irrigator, and fan retractor.

Patient Positioning and Operating Room Setup

The patient is placed supine, and straps are used to secure the patient during steep table position changes. The patient is fixed in a moldable "bean bag" form with both arms tucked in, and placed in a modified lithotomy position using levitator stirrups **(Figs. 5 and 6)**. A urinary catheter is placed in the bladder, and the stomach is decompressed with a nasogastric tube. Identical operating room personnel is used for the laparoscopic case as for an open right hemicolectomy.

The nurse is on the patient's right. This is also where the assistant stands, with the surgeon on the patient's left side facing the right colon. Hasson (open) technique is preferred to safely insert the first port through the umbilicus. After establishing pneumoperitoneum, the surgeon tries to expose the right mesocolon and to mark the lower border of the ileocolic vessels.

After initial exploration ensures no prohibitive adhesions, two additional 10–12 mm ports are placed under direct visualization, one in the left upper quadrant (in or lateral to the rectus, avoiding the epigastric vessels, approximately a handbreadth from the supraumbilical port) and one in the suprapubic midline. Once all the trocars are in place, the assistant moves to the patient's left side to direct the camera. To start the initial dissection, the surgeon moves between the patient's legs, the assistants position themselves on the patient's left side, and the nurse stands near the patient's right knee. The primary monitor is placed near the patient's right shoulder to give the surgeon and the assistant's optimal viewing **(Fig. 7)**.

The second monitor is placed on the left side close to the head, a location that gives the best view for the nurse.

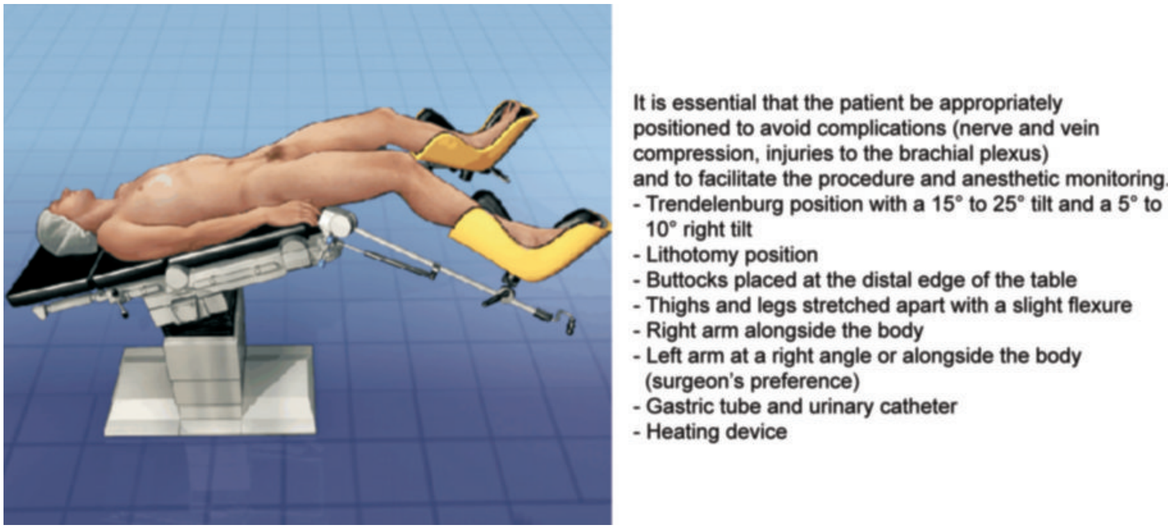


Fig. 5: Position of patient for colorectal surgery.

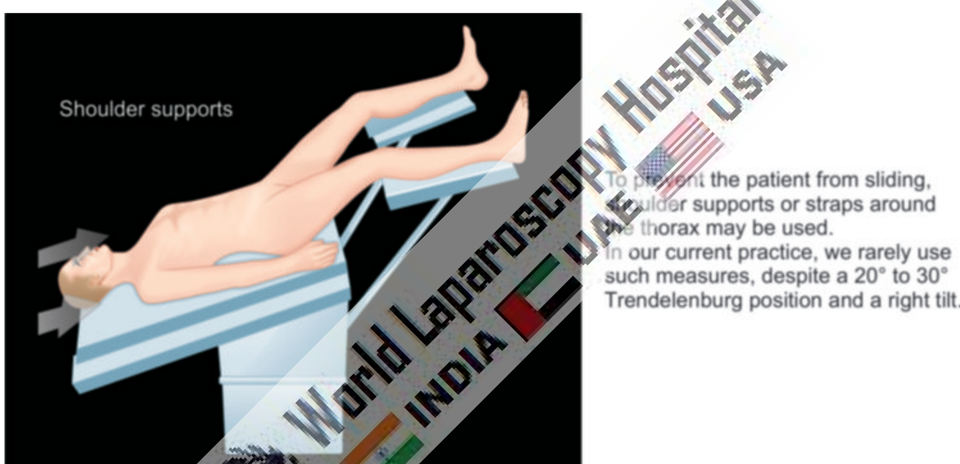


Fig. 6: Shoulder support to prevent sliding during colorectal surgery.

After completing the proximal vessel ligation with lymphadenectomy and mobilization of the terminal ileum and the cecum, the surgeon moves back to the patient's left side, and the first assistant stands between the patient's legs for take-down of right flexure and whole mobilization of the right colon **(Fig. 8)**.

Operative Technique

Right colectomy can be broadly divided in the following steps:
- Ligation of ileocolic vessels
- Identification of right ureter
- Dissection along the superior mesenteric vein
- Division of omentum
- Division of right branch of middle colic vessels
- Transection of the transverse colon
- Mobilization of the right colon
- Transection of the terminal ileum
- Ileocolic anastomosis
- Delivery of specimen

The patient is positioned in Trendelenburg with the right side inclined upward. This allows the small bowel and omentum to fall toward the left upper quadrant, exposing the cecum and assisting in retraction. The omentum and transverse colon are moved toward the upper abdomen, the ventral side of the right mesocolon is well visualized, and the optimal operative field can be achieved. The small bowel is mobilized out of the pelvis by grasping the peritoneum, not bowel wall, near the base of the cecum and pulling cephalad and to the left. The appropriate plane along the base of the small bowel mesentery and around the cecum can be seen and the peritoneum overlying it carefully opened, exposing the correct retroperitoneal plane.

The ureter is identified either before opening the peritoneum in a thin patient or after, being visualized as it courses over the right iliac vessels. Dissection is then continued around the base of the cecum. Moving cephalad and laterally, the white line of Toldt is incised as the right colon is retracted medially and cephalad by grasping the cut edge of the peritoneum, not the bowel.

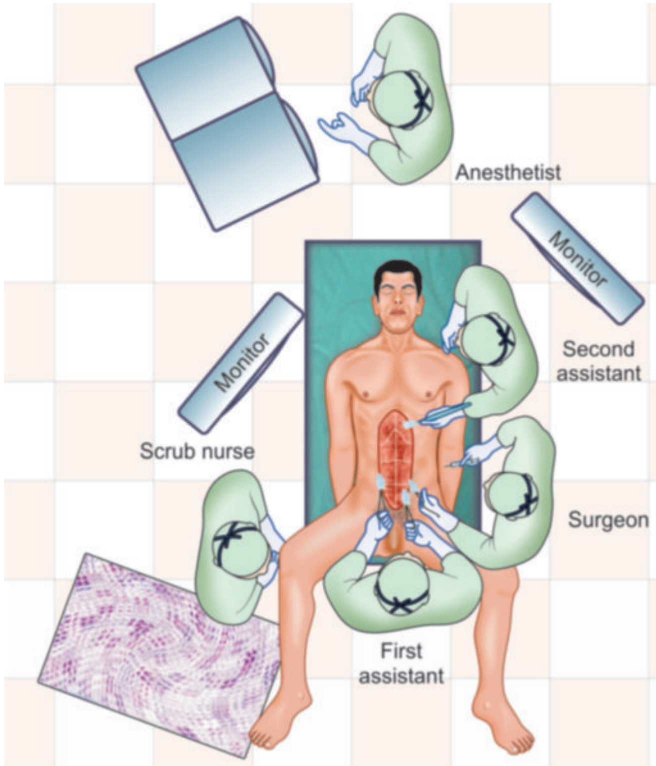


Fig. 7: Position of surgical team during colorectal surgery.

Before starting the dissection, the ileocolic pedicle must be definitively identified by retracting the right mesocolon. Various approaches, such as lateral-to-medial (lateral approach), medial-to-lateral (medial approach), and retroperitoneal approach, have been documented. The medial approach is quite effective for complete lymphadenectomy with early proximal ligation, minimal manipulation of the tumor-bearing segment, and ideal entry to proper retroperitoneal plane.

Various approaches to the right colon mobilization have been described.

- Lateral to medial ("classic" open approach)
- Medial to lateral approach
- Retroperitoneal approach

It is believed that the medial approach is optimal in order to maintain conventional oncologic principles. First, the mesocolon near the ileocecal junction is lifted to confirm the ileocolic pedicle. The root of the ileocolic pedicle is usually located at the lower border of the duodenum. The independent right colic vessels, if present, are located at the upper border at the duodenum. However, the majority of patients do not have the independent right colic vessels (vessels originating directly from the superior mesenteric artery and vein **(Figs. 9A and B)**. The surgeon should initially stand on the patient's left side to confidently know the ileocolic pedicle from the superior mesenteric vessels, and to mark the lower border of the ileocolic pedicle.

Once the ileocolic pedicle is identified, the surgeon moves between the patient's legs and the scope is inserted

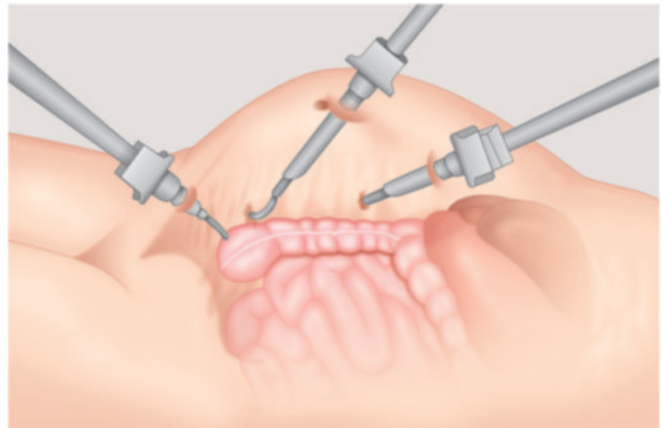


Fig. 8: Mobilization of cecum and right colon.

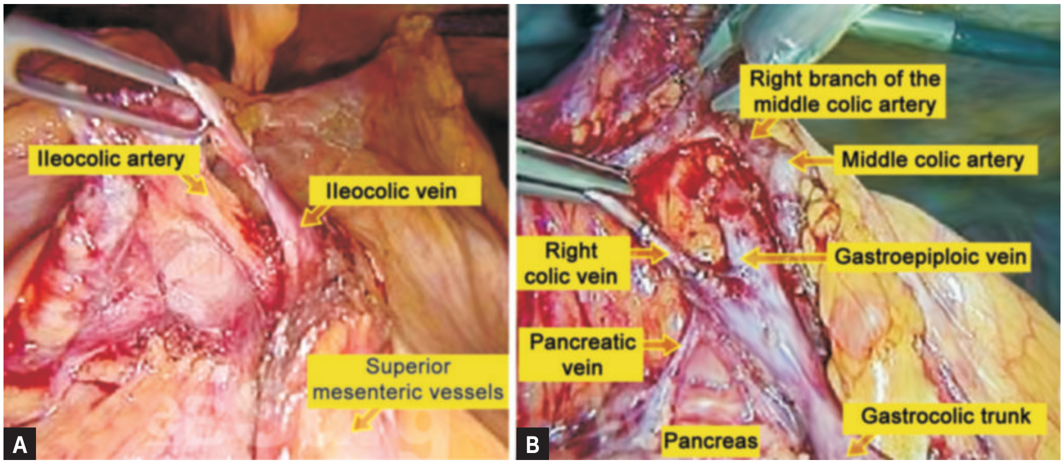
through the suprapubic port. The medial side of the right mesocolon is first incised, starting from the previously marked region below the ileocolic pedicle, followed by the incision of the peritoneum over to the superior mesenteric vessels. This is done before mobilization of the right colon. With adequate traction of mesocolon toward the right upper quadrant, the ileocolic vessels are easily mobilized from the subperitoneal fascia leading onto the duodenum. Their origins are identified from the superior mesenteric vessels at the lower border of the duodenum and divided.

The surgeon's first step in the dissection is to mark the inferior border of the ileocolic pedicle. From between the legs, the surgeon dissects the peritoneum overlying the ileocolic vascular pedicle over to the superior mesenteric vessels.

After mobilization of the ileocolic pedicle from the duodenum, the dissection of the ventral side of the superior mesenteric vein (SMV) leads to the dissection of the origin of the ileocolic artery. In type B, the ileocolic artery is running behind the superior mesenteric vein. After mobilization and division of the ileocolic pedicle from the duodenum, the dissection of the ventral side of the SMV leads to a complete dissection of the root of the middle colic artery and vein.

Careful dissection onto the duodenum and the caudad portion of the pancreas must be exercised in the exposure of the middle colic vessels. Dissection around Henle's trunk (the truck of mesenteric veins consisting of the gastroepiploic vein fusing with the right branch of the middle colic vein or the main middle colic vein) may lead to the exposure of an accessory right colic vein. Accessory right colic vein and right branches of middle colic vessels are clipped and divided. However, if an accessory right colic vein is difficult to confirm in this situation, this vein may be easily detected later at the take-down of the right flexure.

After securing the vessels, the operating table is tilted into the steep Trendelenburg position with the right side down to move the small intestine toward the right upper quadrant. After confirming the right ureter and gonadal vessels



Figs. 9A and B: (A) Position of major blood vessels at the time of surgery; (B) Important vessels supplying right side of colon.

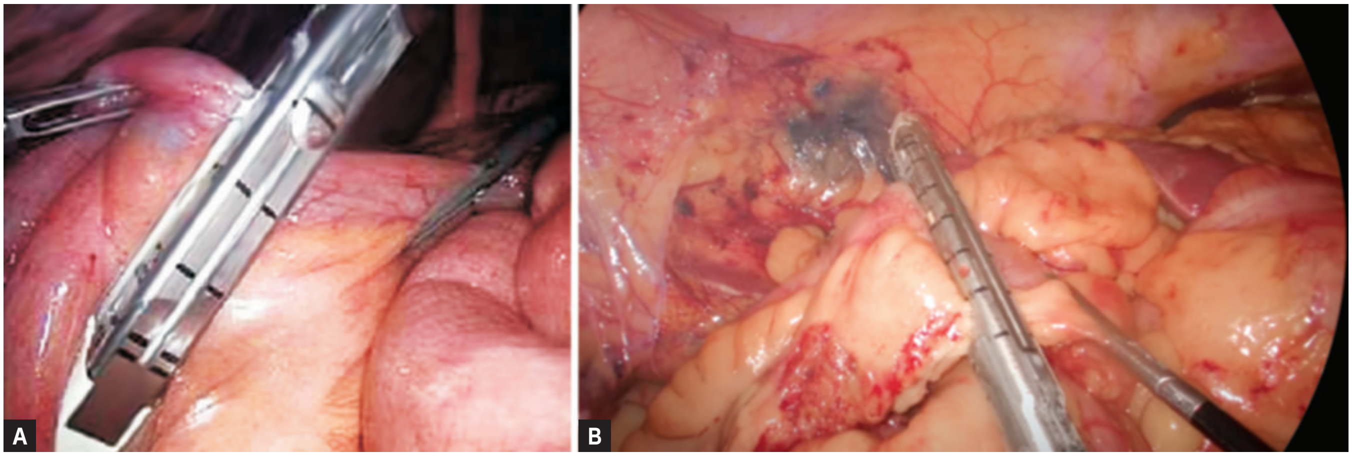
Figs. 10A and B: Specimen of right side of colon after right colectomy.

through the subperitoneal fascia at the right pelvic brim, the peritoneum is incised along the base of the ileal mesentery upward to the duodenum, and the ileocecal region is mobilized medially to lateral. After this mobilization, the surgeon moves back to the patient's left side, and the scope is inserted through the umbilical port. The right mesocolon is mobilized from medial to lateral. Again, this approach allows dissection into the proper retroperitoneal plane. The right gonadal vessels and ureter are safe from injury in this plane, so exposing them is not necessary. This approach also allows the surgeon to work in a straight path from medial to lateral, without tissue to obstruct the vision that can occur while working from lateral to medial. This plane connects the previous dissection plane from the caudad side.

The anatomy around the right flexure is essential to avoid inadvertent bleeding, especially from around Henle's (gastrocolic) trunk. However, if the previous mesenteric dissection is fully performed from the caudad side and the accessory right colic vein is divided, the right flexure is easily taken down only by dividing the hepatotoxic ligament. If the accessory right colic vein is difficult to detect at the previous dissection, it can be easily confirmed from Henle's trunk at this situation and should be divided before extracting the right colon to avoid its injury. Up to this point, the primary tumor has been minimally manipulated using medial to lateral approach. Finally, the right flexure and right colon, including the tumor-bearing segment, are detached laterally, which completes the mobilization of the entire right colon **(Figs. 10A and B)**.

Once the entire right colon is freed, it is withdrawn through an enlargement of the port site at the umbilicus. The wound must be covered with a wound protector to prevent contamination or metastasis. The resection of ileum and transverse colon, and the anastomosis are accomplished extracorporeally by the functional end-to-end anastomotic method using conventional staplers or by a hand-sewn method **(Figs. 11A and B)**. The anastomotic site is returned to the peritoneal cavity. Wounds and peritoneal cavity are copiously irrigated. All wounds are closed, and operation is completed.

The identification of a small tumor in the colon may be difficult even in conventional open surgery. In laparoscopic surgery, where there is no tactile sensation, pre- or intraoperative marking of the tumor is frequently needed.



Figs. 11A and B: Transaction of ileum by the stapler.

Various kinds of marking methods are available, e.g., dye injection and mucosal clip placement by preoperative colonoscopy, which has been reported for the tumor localization. Several reports demonstrated the usefulness of tattooing the colonic wall adjacent to the tumor with India ink in four quadrants using preoperative colonoscopy.

However, effective injection in all four points of the bowel is sometimes challenging to achieve. In some cases, surgeons failed to achieve serosal staining visible at laparoscopy, which forced them to use intraoperative colonoscopy. This complicated the laparoscopic colonic resection because of the distended bowel related to air insufflation during colonoscopy.

Conclusion

Right-sided colon cancer can be adequately treated by proper laparoscopic procedures adherent to the oncologic principles. Port-site metastasis after laparoscopic colon cancer surgery is unlikely to be a major risk factor when the procedure is performed according to oncologic principles. It is believed that laparoscopic right colectomy for cancer performed by expert surgeons is accepted as less invasive surgery without sacrificing the survival benefit compared with conventional open right colectomy.

SIGMOIDECTOMY

Laparoscopic sigmoid colon resection is indicated for both benign (diverticulitis, segmental Crohn's disease, polyp unresectable by colonoscopy) and malignant (primary colon cancer) etiologies, and is one of the most common operations done by laparoscopic methods. In chronic diverticular disease, the indications for laparoscopic sigmoid resection are the same as for open surgery. Sigmoid colectomy for diverticulitis can be technically challenging because of severe inflammation in the left lower quadrant and pelvis.

Patient Positioning and Operating Room Setup

A proper patient position is key to both facilitating operative maneuvers and preventing complications such as nerve and vein compression and traction injuries to the brachial plexus. The patient is placed supine, in the modified lithotomy position, with legs abducted and slightly flexed at the knees. The patient's right arm is alongside the body, whereas the left arm is usually placed at a 90° angle. Adequate padding is used to avoid compression on bone prominences.

A nasogastric or orogastric tube and a urinary catheter are placed. Adequate thromboembolism prophylaxis should be used, as preferred by the surgeon, and intermittent leg compression stockings can be used as well. The procedure is usually performed with two assistants and a scrub nurse (**Fig. 12**). The surgeon is on the right side of the patient, and the second assistant is also on the right side. The first assistant stands between the patient's legs and the scrub nurse at the lower right side of the table. The team remains in the same position throughout the entire procedure. It is advisable to use a table that can be easily tilted laterally and placed into steep Trendelenburg and reverse Trendelenburg position in order to facilitate exposure of the pelvic space and of the splenic flexure. The laparoscopic unit with the main monitor is located on the left side of the table. It is useful to use a second monitor placed above the patient's head.

Cannula Positioning

Standardize cannula placements are five or six cannulae for left-sided colectomies. This allows us to achieve excellent exposure, which may be particularly valuable at the beginning of a surgeon's learning curve. Using six cannulae allows the use of more instruments in the abdominal cavity for retraction of bowel and structures, especially in the presence of abundant intra-abdominal fat or the dilated small bowel, as well as during mobilization of the splenic flexure.

Cannula fixation to the abdominal wall is essential, to avoid CO_2 leakage, and in cases of malignancy, to minimize the passage of tumor cells and help reduce the incidence of port-site metastases. This is mainly achieved by fitting the size of the incision to the cannula size or by fixing the

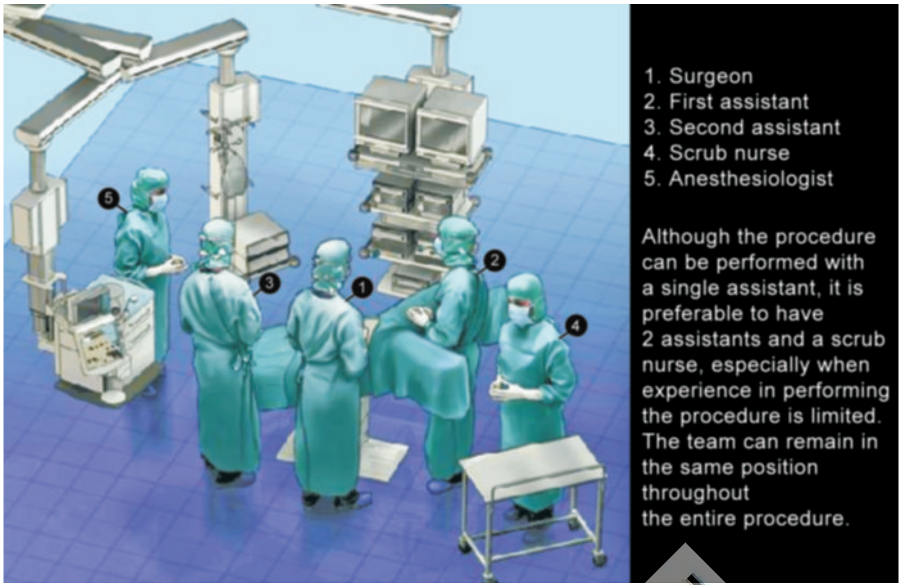


Fig. 12: Position of surgical team in colorectal surgery.

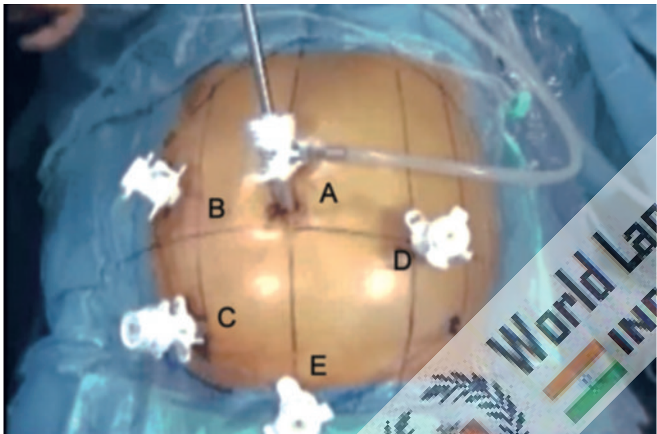


Fig. 13: Port position for sigmoidectomy for benign disease.

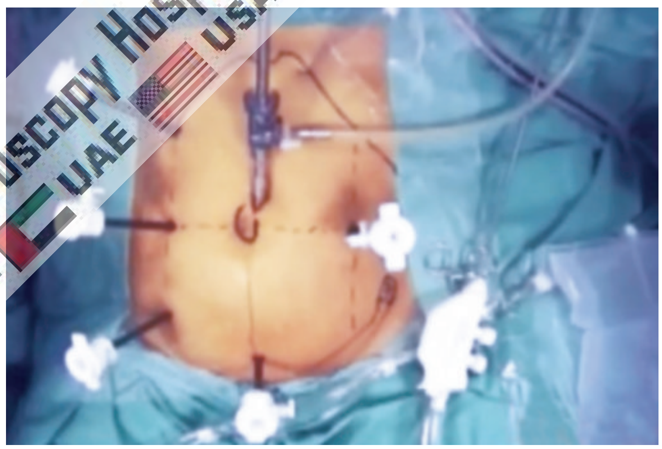
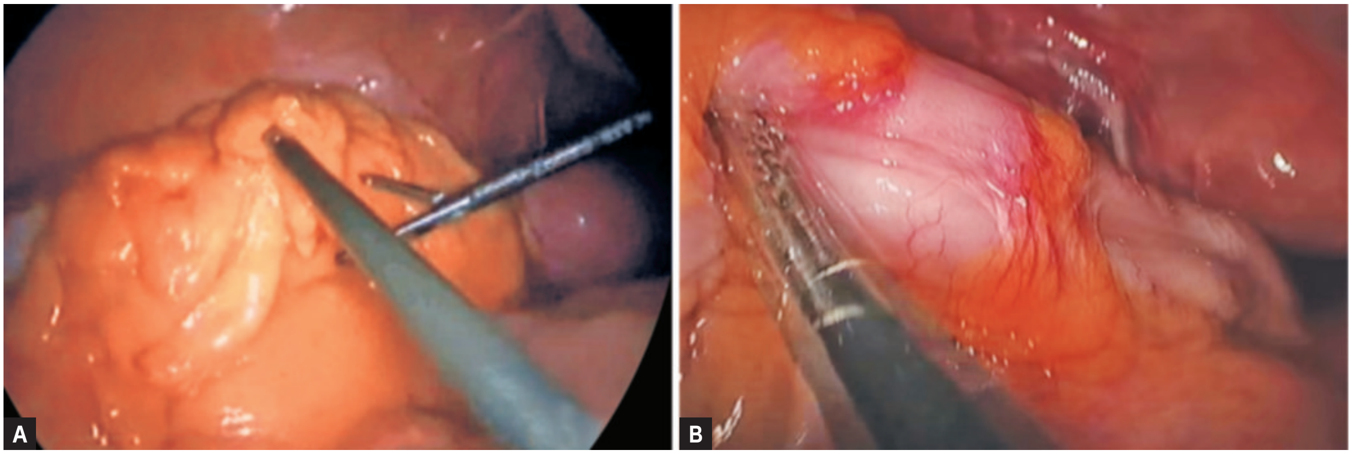


Fig. 14: Alternating port position for sigmoidectomy for malignant disease.

cannula to the abdomen with a suture placed around the stopcock of the cannula. Use of screw-like cannulae has drawbacks that it increases the parietal trauma. Generally, it is better to perform an "open" technique for the insertion of the first cannula, which is placed at the midline, above the umbilicus, to reduce the risk of injury of abdominal organs. With some experience, the task becomes easy and very rapid. However, in the case of previous abdominal surgery, we usually inflate the abdominal cavity using the Veress needle in the left subcostal area, in order to insert the first cannula as far lateral as possible, in the right hypochondrium, to avoid potential areas of adhesions.

The first cannula (12 mm), which is used for the optical device, is positioned on the midline 3–4 cm above the umbilicus. The two operating cannulae are introduced, one at the junction between the umbilical line and the right midclavicular line, and the other 8–10 cm inferiorly, on the same line. The latter is a 12 mm operating cannula to allow the introduction of a linear stapler at the time of bowel resection. This cannula accommodates the following: scissors (monopolar, high-frequency hemostasis device, clip, staplers), a monopolar hook, surgical loops, a suction-irrigation device, and an atraumatic grasper. A fourth cannula is placed on the left midclavicular line at the level of the umbilicus. This is a 5-mm cannula, which accommodates an atraumatic grasper used for retraction and exposure during the medial approach for the dissection of the left mesocolon. When performing mobilization of the splenic flexure, this cannula becomes an operating cannula. A fifth 5-mm cannula is placed 8–10 cm above the pubic bone, on the midline, and is used for retraction **(Figs. 13 and 14)**.

For most of the procedure, it accommodates a grasper used to expose the sigmoid and descending mesocolon. At the end of the procedure, the incision at this cannula's site is lengthened to allow extraction of the specimen. Some surgeons sometimes use an additional cannula, which is a



Figs. 15A and B: Exposure of sigmoid colon after shifting the omentum upward.

5 mm cannula situated on the right midclavicular line in the subcostal area and accommodates an atraumatic grasper used to retract the terminal portion of the small intestine laterally at the beginning of the dissection and to retract the transverse colon during the mobilization of the splenic flexure.

Operative Technique

Exposure

To complete exposure of the operative field, active positioning of the bowel is usually necessary in addition to the passive action of gravity, especially in the presence of obesity or bowel dilatation. The greater omentum and the transverse colon are placed in the left subphrenic region and maintained in this position by the Trendelenburg tilt. An atraumatic retractor, introduced through the cannula on the left side, may also be used. Subsequently, the proximal small bowel loops are placed in the right upper quadrant using gentle grasping **(Figs. 15A and B)**.

The distal small bowel loops are placed in the right lower quadrant with the cecum and maintained there with gravity. If gravity is not sufficient, as occurs mainly in the presence of abundant intra-abdominal fat or dilated bowel, an additional maneuver is used. An instrument passed through the right subcostal cannula is passed at the root of the mesentery and grasps the parietal peritoneum of the right iliac fossa; the shaft of the grasper thus provides an autostatic retraction of the bowel loops, keeping them away from the midline and the pelvic space. This technique of exposure offers an excellent view of the sacral promontory and the aortoiliac axis. This particular view on the operative field is essential for the medial-to-lateral vascular approach.

The uterus may be an obstacle to adequate exposure in the pelvis. In postmenopausal women, the uterus can be suspended to the abdominal wall by a suture **(Fig. 16)**. This suture is introduced halfway between the umbilicus and the pubis and opens the rectovaginal space. In younger women, the uterus can be retracted using a similar suspension by a suture around the round ligaments or using a 5-mm retractor passed through the suprapubic cannula. Very often, conversion to open surgery is caused by difficulty in exposure, not only at the beginning but also throughout the procedure.

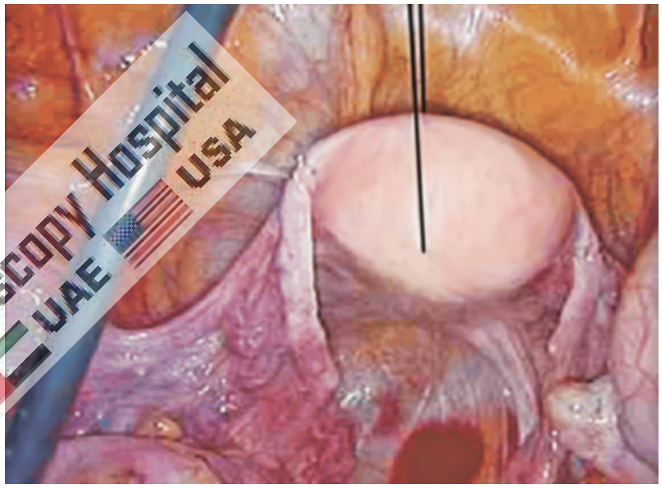


Fig. 16: Securing the uterus by suture for proper exposure of rectum.

To perform a medial approach, time is dedicated to the perfect achievement of this exposure, which will serve not only for the initial vascular approach, but also for about half of the remaining operative time. After adequate exposure has been achieved, the following steps of the technique include the vascular approach, the medial posterior mobilization of the sigmoid, the extraction of the specimen, and the anastomosis. Additional steps include the mobilization of the splenic flexure, performed when further lengthening of the bowel is needed to perform a tension-free anastomosis.

This step of the exposure is preliminary, and it is done in a similar manner, regardless of the type of disease. The remainder of the procedure is different if the indication for surgery is cancer or benign disease.

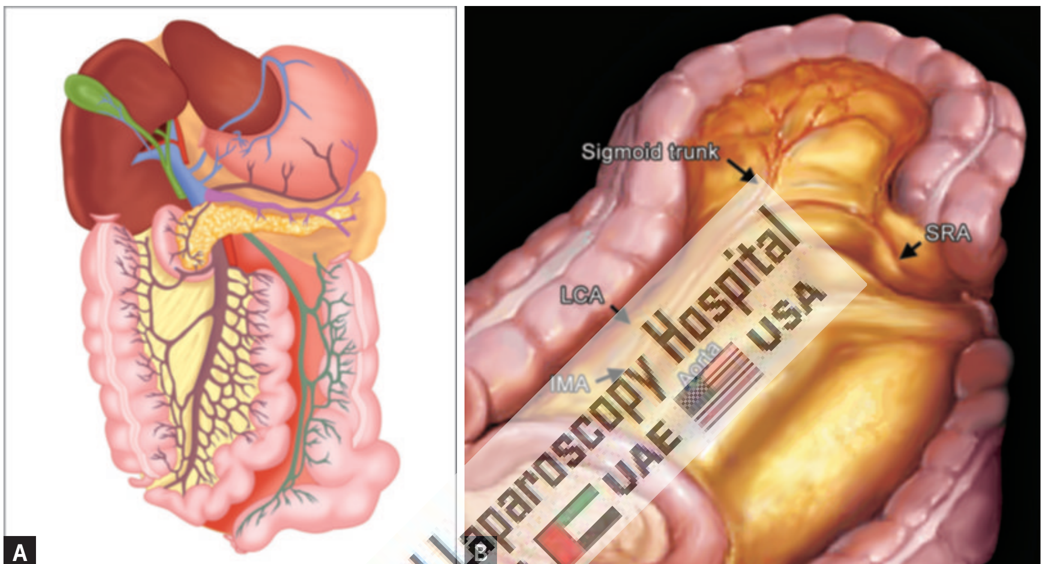
Sigmoid Colon Resection for Cancer

In laparoscopic colorectal sigmoidectomy for cancer or for benign disease, the vascular approach is the first step of the dissection. It is believed that it allows us to avoid unnecessary manipulation of the colon and tumor, which may cause tumor cell exfoliation, and to perform a good lymphadenectomy following the vascular anatomy. The vessels are gradually exposed once the peritoneum at the base of the sigmoid mesocolon is incised **(Figs. 17A and B)**. The medial-to-lateral view allows us to see the sympathetic nerve plexus trunks, the left ureter, and gonadal vessels, avoiding ureteral injuries and possibly preserving genital function.

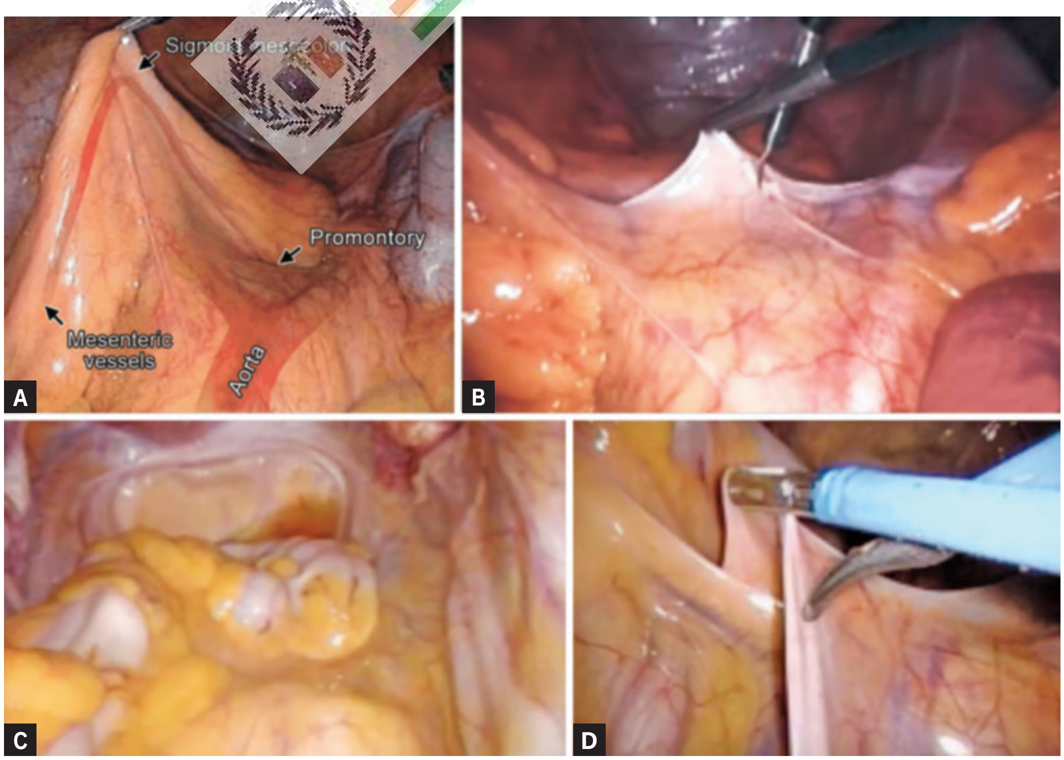
Primary Vascular Approach (Medial Approach)

Peritoneal Incision

The sigmoid mesocolon is retracted anteriorly, using a grasper introduced through the suprapubic cannula: This exposes the base of the sigmoid mesocolon. The visceral peritoneum is incised at the level of the sacral promontory **(Figs. 18A to D)**. The incision is continued upward along the right anterior border of the aorta up to the ligament of



Figs. 17A and B: Vascular supply of left side of colon.
(SRA: superior rectal artery; LCA: left colic artery; IMA: inferior mesenteric artery)



Figs. 18A to D: Incision of peritoneum over sacral promontory.

Treitz. The pressure of the pneumoperitoneum facilitates the dissection, as the diffusion of CO_2 opens the avascular planes.

Identification of the Inferior Mesenteric Artery

The dissection of the cellular adipose tissue is continued upward by gradually dividing the sigmoid branches of the right sympathetic trunk. The dissection behind the inferior mesenteric artery (IMA) involves preservation of the main hypogastric nerve trunks but also division of the small branches traveling to the colon to expose the origin of the IMA (**Figs. 19A and B**). To ensure an adequate lymphadenectomy, the first 2 cm of the IMA are dissected free, and the artery is skeletonized before it is divided.

This dissection at the origin of the IMA involves a risk of injury to the left sympathetic trunk situated on the left border of the inferior mesenteric artery. A meticulous dissection of the artery (skeletonization) helps to avoid this risk, because only the vessel will be divided, and not the surrounding tissues. Dissection performed close to the artery also minimizes the risk of ureteral injury during the ligation of the inferior mesenteric artery. The IMA can then be divided between clips, or by using a linear stapler (vascular 2.5 or 2.0-mm cartridges. The artery is divided at 1–2 cm distal to its origin from the aorta ideally after the take-off of the left colic artery **(Figs. 20A to H)**.

Identification of the Inferior Mesenteric Vein

The inferior mesenteric vein (IMV) terminates when reaching the splenic vein, which goes on to form the portal vein with the SMV. Anatomical variations include the IMV draining into the confluence of the SMV and splenic vein and the IMV draining in the SMV.

The IMV is identified to the left of the IMA or in case of difficulty, higher, just to the left of the ligament of Treitz junction **(Fig. 21)**. The vein is divided below the inferior border of the pancreas or above the left colic vein. Once again, clips are sure options to ligate and divide this vessel **(Figs. 22A to D)**.

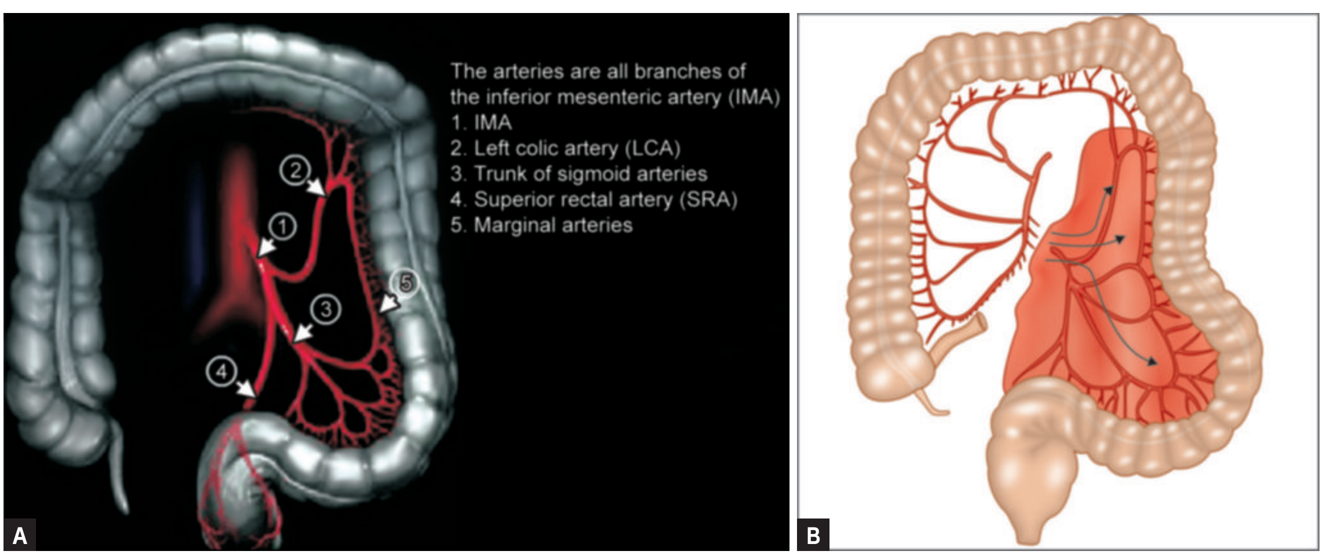
Mobilization of the Sigmoid and Descending Colon

The mobilization of the sigmoid colon follows the division of the vessels. This step includes the freeing of posterior and lateral attachments of the sigmoid colon and mesocolon and the division of the rectal and sigmoid mesenteries. The approach is either medial or lateral. It is wise to routinely perform this medial-to-lateral laparoscopic dissection for all indications. The medial approach is well adapted for laparoscopy because it preserves the working space and demands the least handling of the sigmoid colon. In a randomized trial comparing the medial-to-lateral laparoscopic dissection with the classical lateral-to-medial approach for resection of rectosigmoid cancer, Liang et al. showed that the medial approach reduces operative time and the postoperative proinflammatory response. Besides the potential oncologic advantages of early vessel division and "no-touch" dissection, it is believed that he longer the lateral abdominal wall attachments of the colon are preserved, the easier are the exposure and dissection.

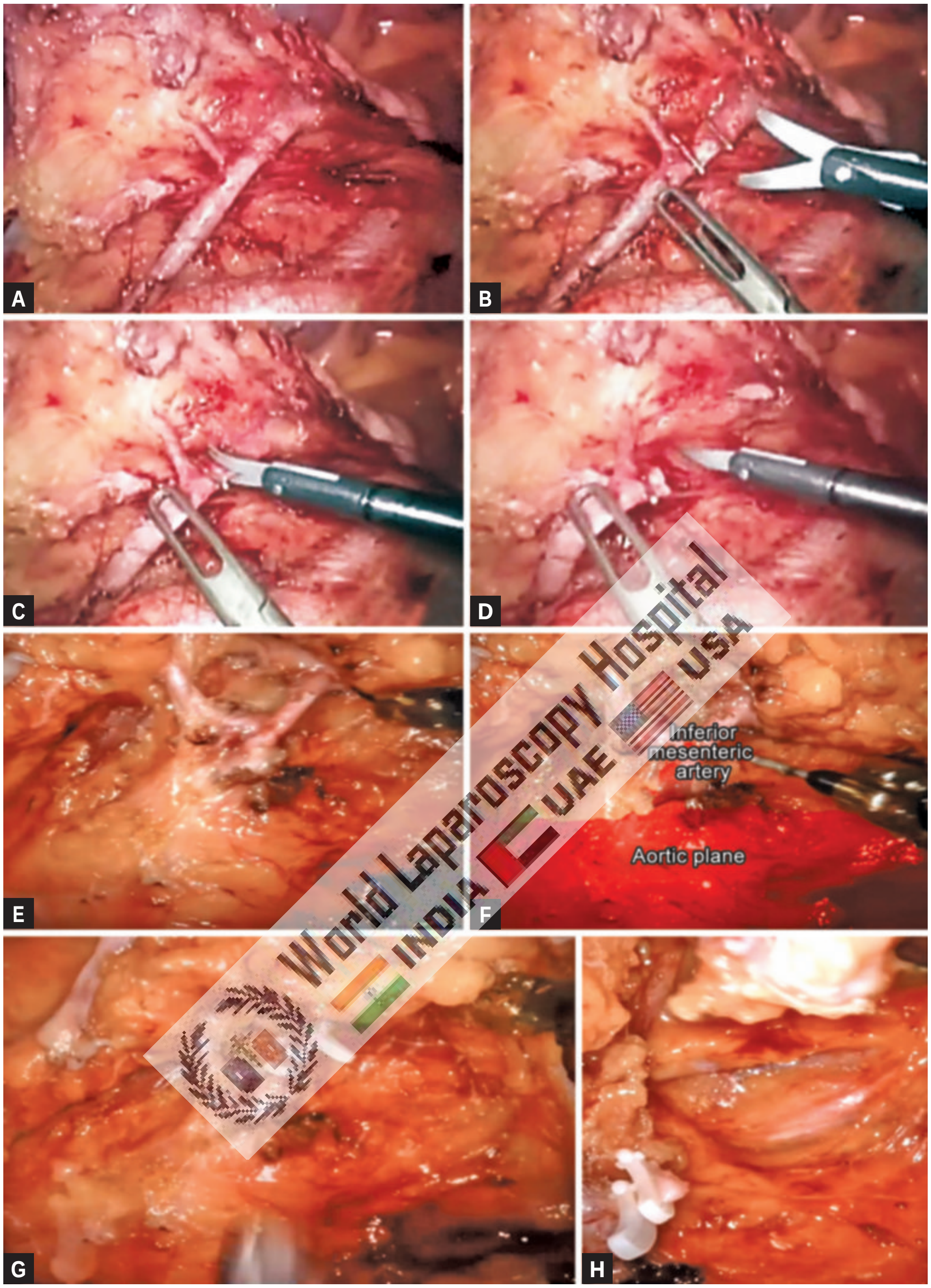
Posterior Detachment

The sigmoid mesocolon is retracted anteriorly using the suprapubic cannula to expose the posterior space. The plane between Toldt's fascia and the sigmoid mesocolon can then be identified. This plane is avascular and easily divided.

The dissection continues posteriorly to the sigmoid mesocolon going laterally toward Toldt's line. The sigmoid colon is then completely free, and the lateral attachments can then be divided using a lateral approach.



Figs. 19A and B: Arterial supply of sigmoid colon.



Figs. 20A to H: Dissection of inferior mesenteric artery

Lateral Mobilization

The extent of the dissection is superiorly formed by the inferior border of the pancreas, laterally following Gerota's fascia and inferiorly the psoas muscle where the ureter crosses the iliac vessels. The sigmoid loop is pulled toward the right upper quadrant (grasper in right subcostal cannula) to exert traction on the line of Toldt **(Fig. 23)**. The peritoneal fold is opened cephalad and caudad, and the dissection joins the one previously performed medially. During this step, care must be taken to avoid the gonadal vessels and the left ureter because they can be attracted by the traction exerted on the

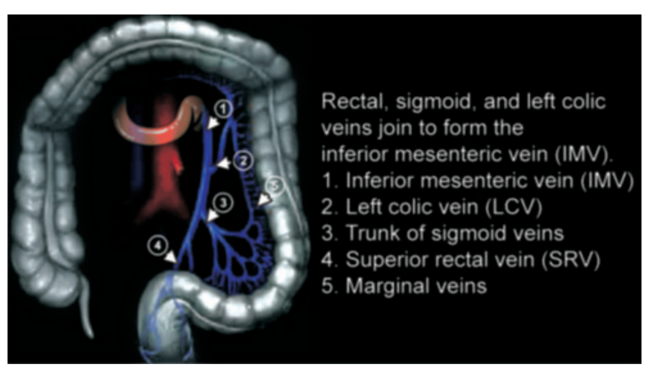
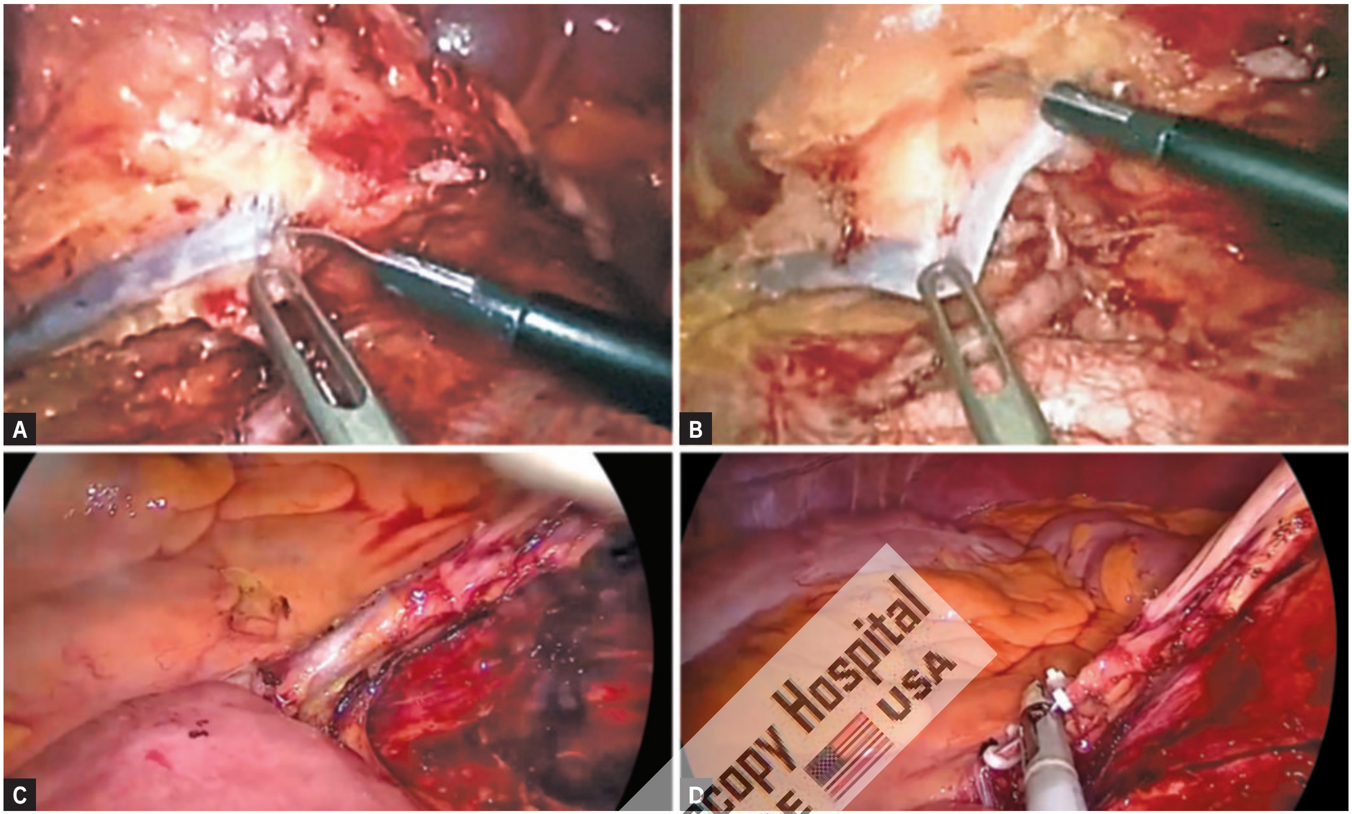


Fig. 21: Venous supply of sigmoid colon.



Figs. 22A to D: Dissection of inferior mesenteric vein.

mesentery. Ureteral stenting (infrared stents) can be useful in cases in which inflammation, tumoral tissue, or adhesions and endometriosis make planes difficult to recognize.

Dissection of the Upper Mesorectum

This area of dissection should be approached with caution, especially on the left side. The mesorectum there is closely attached to the parietal fascia where the superior hypogastric nerve and the left ureter are situated. The upper portion of the rectum is mobilized posteriorly following the avascular plane described before, then laterally, until a sufficient distal margin is achieved **(Figs. 24A to D)**.

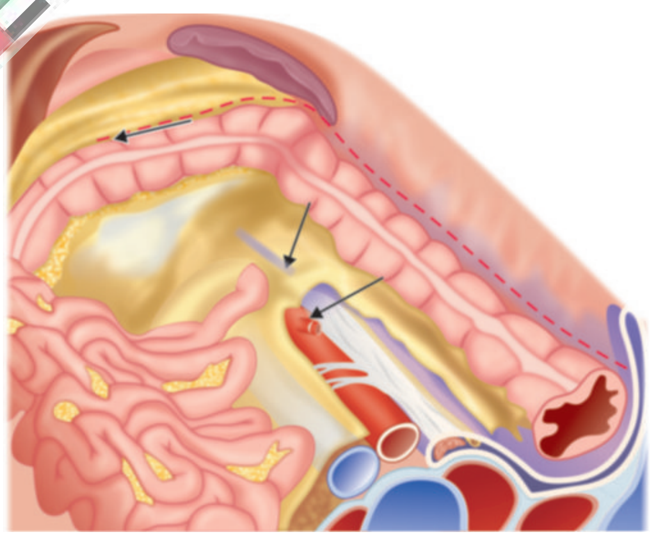


Fig. 23: Lateral approach.

Resection of the Specimen

Division of the Rectum

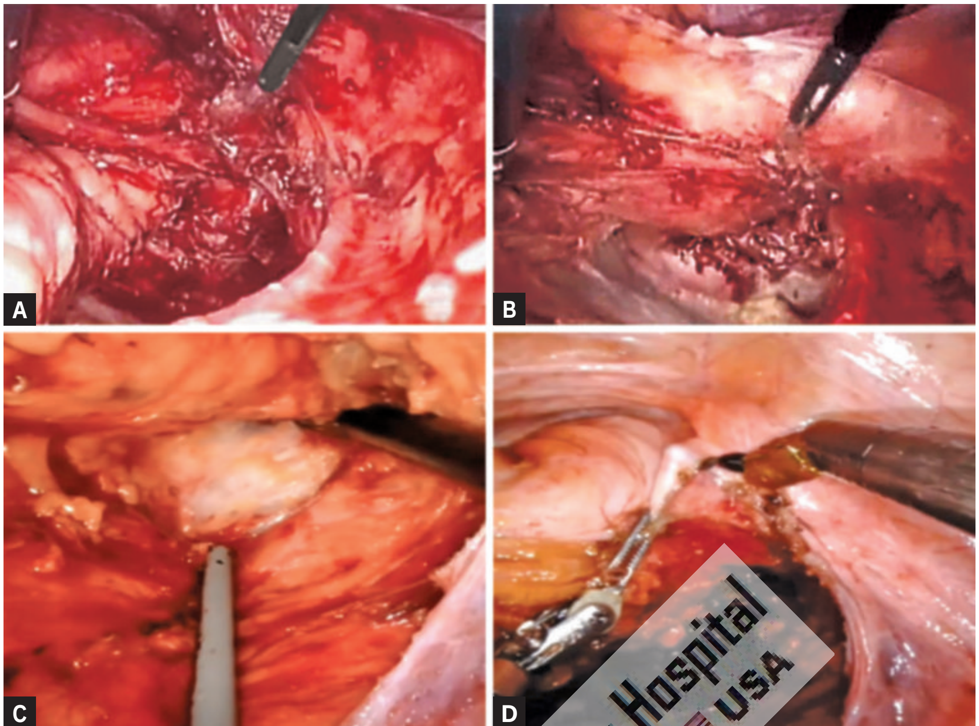
Once the upper rectum is freed, the area of distal resection is chosen, allowing a distal margin of at least 5 cm. The fat surrounding this area is cleared, using monopolar cautery, ultrasonic dissection, or the LigaSure™ device. Doing so, the superior hemorrhoidal arteries are divided in the posterior upper mesorectum. The distal division is performed using a linear stapler.

The stapler is introduced through the right lower quadrant cannula. It is wise to use stapler loads 3.5 mm, 45 mm blue cartridges, which are applied perpendicular to the bowel **(Figs. 25A to F)**. Articulated staplers can also be useful, although they are usually unnecessary at the level of the upper rectum **(Figs. 26A and B)**.

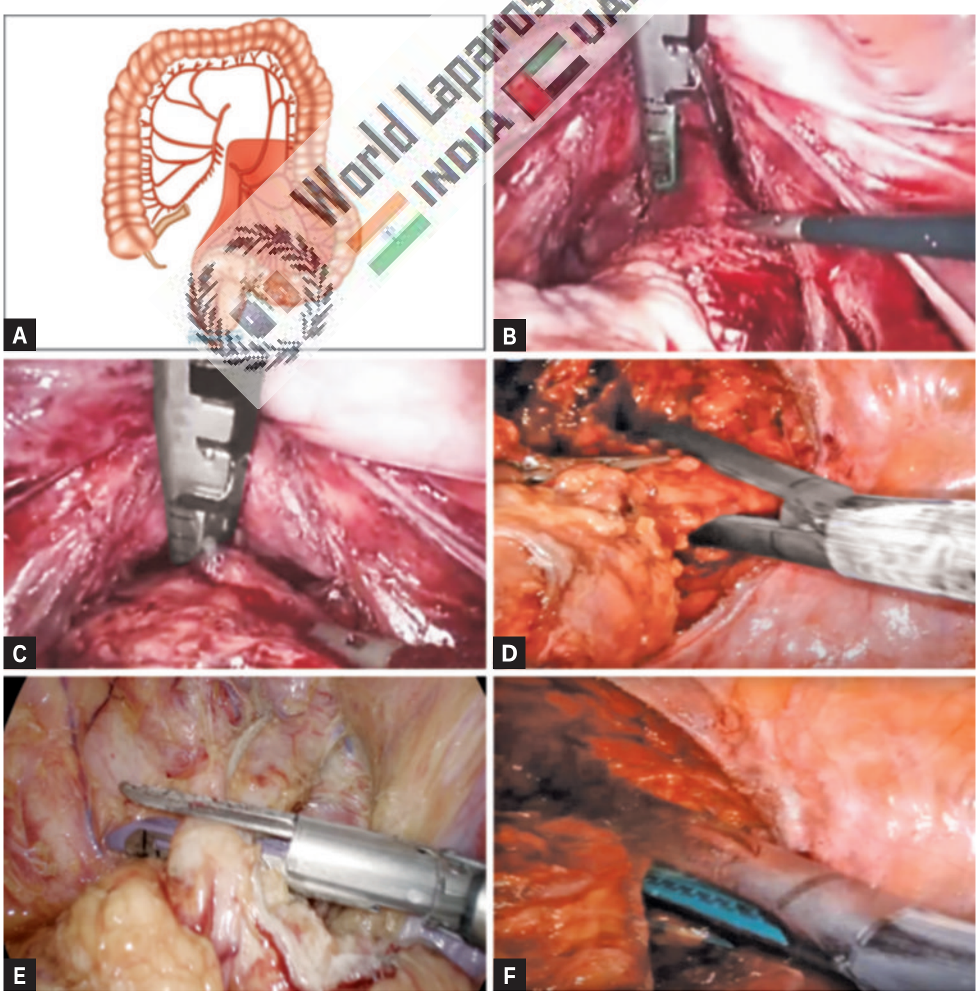
Proximal Division

The proximal division site should be located at least 10 cm proximal to the tumor. It is performed by first dividing the mesocolon and, subsequently, the bowel **(Fig. 27)**.

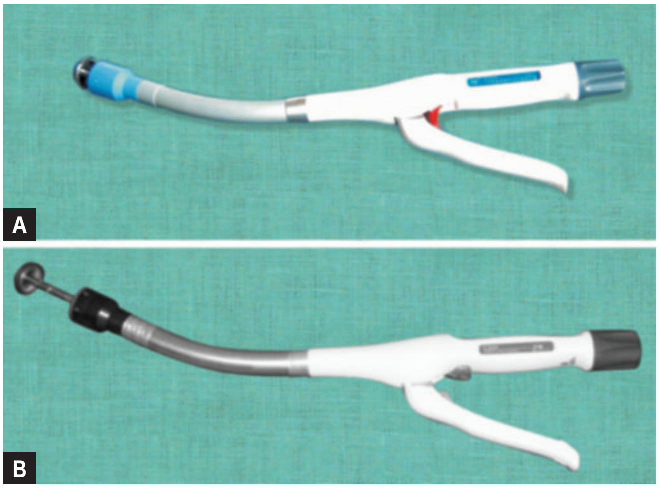
The division of the mesocolon is more easily performed with the harmonic scalpel, or the LigaSure™, although linear staplers can also be used. The distal portion of the divided



Figs. 24A to D: Dissection of upper mesorectum.



Figs. 25A to F: Division of rectum using stapler.



Figs. 26A and B: Disposable circular staplers used in colorectal surgery.

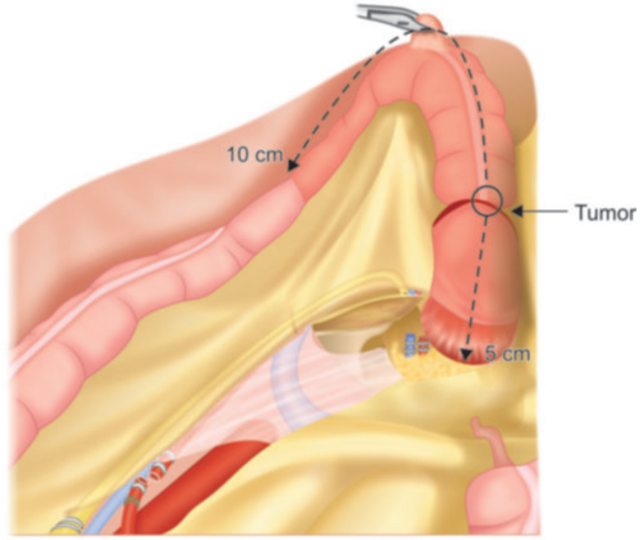


Fig. 27: Division 10 cm proximal and 5 cm distal to tumor.

IMA is identified, and the division of the mesocolon starts right at this level and continues toward the chosen proximal section site at a 90° angle. A linear stapler is then fired across the bowel. The stapler (blue load) is introduced through the right lower quadrant cannula. The specimen is placed in a plastic retrieval sac introduced through the same cannula. This permits the continuation of the procedure without manipulation of the bowel and tumor. If the resected specimen is large and obscures the operative fields, the extraction can be done before completing the mobilization of the left colon.

Mobilization of the Splenic Flexure

In the frequent event that a long segment of the sigmoid colon has been resected, mobilization of the splenic flexure is required. This can be achieved in different ways. It is important for the surgeon to be familiar with all approaches in order to select the most suitable approach. Sufficient mobilization of the splenic flexure may be achieved by simply freeing the posterior and lateral attachments of the descending colon. This is begun by a medial approach to free the posterior attachments of the descending and distal transverse colon, followed by the dissection of the lateral attachments, or by doing the same task in the reverse order. Lateral mobilization is sometimes sufficient in cases of sigmoid cancer, where the posterior mobilization can be omitted.

Lateral Mobilization of the Splenic Flexure

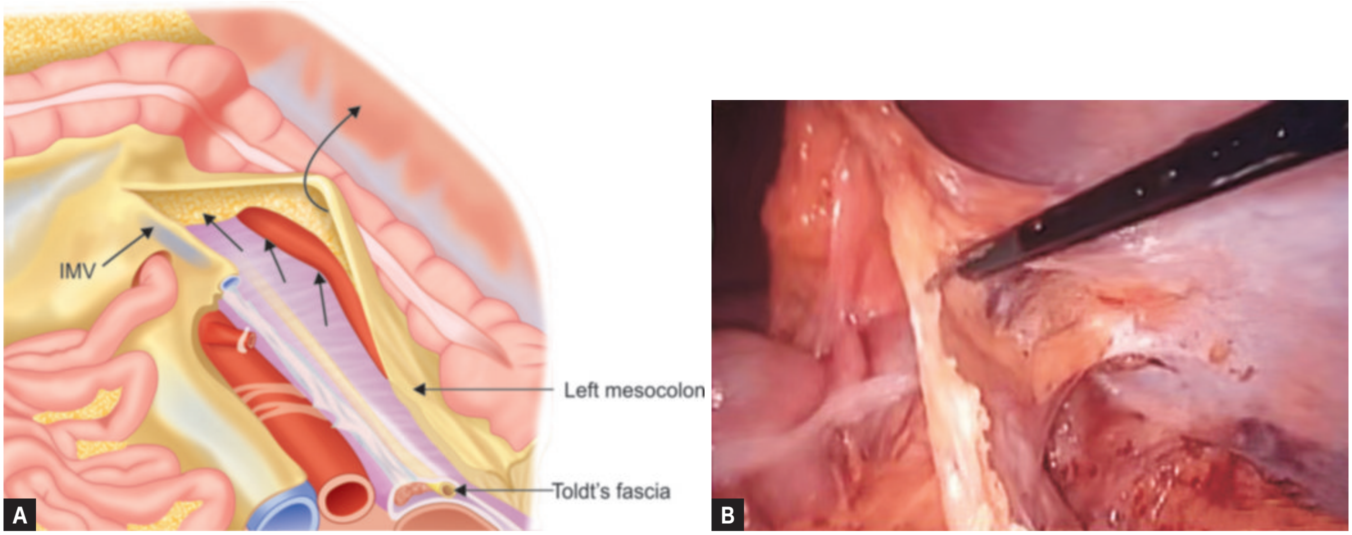
This approach is often used in open surgery and can also be used in simple laparoscopic colectomies. The first step is the section of the lateral attachments of the descending colon. An ascending incision is made along the line of Toldt using scissors introduced via the left-sided cannula. The phrenicocolic ligament is then divided using scissors introduced through this cannula. Retraction of the descending colon and the splenic flexure toward the right lower quadrant using graspers introduced through the right lower and suprapubic cannulae helps to expose the correct plane **(Figs. 28A and B)**. The attachments between the transverse colon and the omentum are divided close to the colon until the lesser sac is opened. The division of these attachments is continued as needed to facilitate the mobilization of the colon into the pelvis.

Medial Mobilization

This approach dissects the posterior attachments of the transverse and descending colon first. The dissection plane naturally follows the plane of the previous sigmoid colon mobilization, cephalad, and anterior to Toldt's fascia. The transverse colon is retracted anteriorly to expose the inferior border of the pancreas, and the root of the transverse mesocolon is divided anterior to the pancreas and at a distance from it, to enter the lesser sac. The dissection then follows toward the base of the descending colon and distal transverse colon, dividing the posterior attachments of these structures. The division of the lateral attachments, as described above, then follows the full mobilization of the splenic flexure. If the mobilized colon reaches the pelvis easily, it may be safely assumed the anastomosis will be tension free as well.

Extraction of Colon

The extraction of the specimen is performed using double protection: A wound protector as well as a retrieval sac **(Figs. 29 and 30)**. The wound protector is also helpful to ensure that there is no CO_2 leak during the intracorporeal colorectal anastomosis, which follows the extraction. This allows a reduction of the size of the incision and potentially minimizes the risk of tumor cell seeding.



Figs. 28A and B: Mobilization of the splenic flexure of the colon.
(IMV: inferior mesenteric vein)

The Incision to Extract the Specimen

The size of the incision, its location, and the extraction technique take into account the volume of the specimen, the patient's body habitus, cosmetic concerns, and the type of disease. The incision is generally performed in the suprapubic region. The proximal division is performed intracorporeally, as described above, and the specimen placed into a thick plastic bag before being extracted through the incision at the suprapubic area.

Anastomosis

For anastomosis, a mechanical circular stapling device passed transanally to perform the anastomosis is used. Performing the anastomosis includes an extra-abdominal preparatory step, and an intra-abdominal step performed laparoscopically.

The extra-abdominal step takes place after the extraction of the specimen. The instrument holding the proximal bowel presents it at the incision where it can easily be grasped with a Babcock clamp and pulled out. If necessary, the colon is divided again in a healthy and well-vascularized zone **(Figs. 31A and B)**.

The anvil (at least 28 mm in diameter) is then introduced into the bowel lumen and closed with a purse-string; then, the colon is reintroduced into the abdominal cavity **(Fig. 32)**. The abdominal incision is closed to re-establish the pneumoperitoneum. For an air-tight closure, it is sufficient to twist the wound protector at the level of the incision using a large clamp **(Figs. 33A and B)**. The circular stapler is introduced into the rectum through the gently dilated anus. The rectal stump is then transfixed with the tip of the head of the circular stapler. In women, the posterior vaginal wall should be retracted anteriorly by the assistant passing the stapler **(Fig. 34)**. Once the center rod and anvil are clicked into the distal part of the circular stapler, twisting of the colon and the mesentery should be checked. The stapler is then fired after ensuring that the neighboring organs are away from the stapling line. The stapler is then twisted open and withdrawn. The anastomosis is checked for leaks by verifying the integrity of the proximal and distal rings, as well as performing an air test **(Figs. 35 and 36)**.

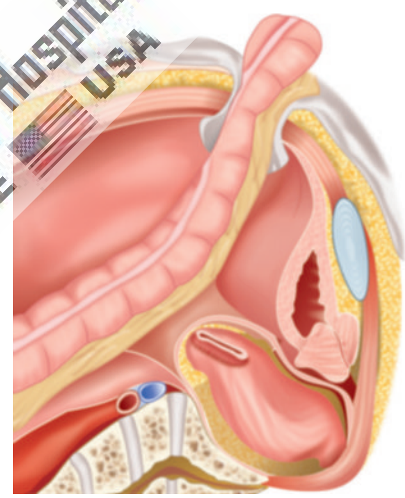
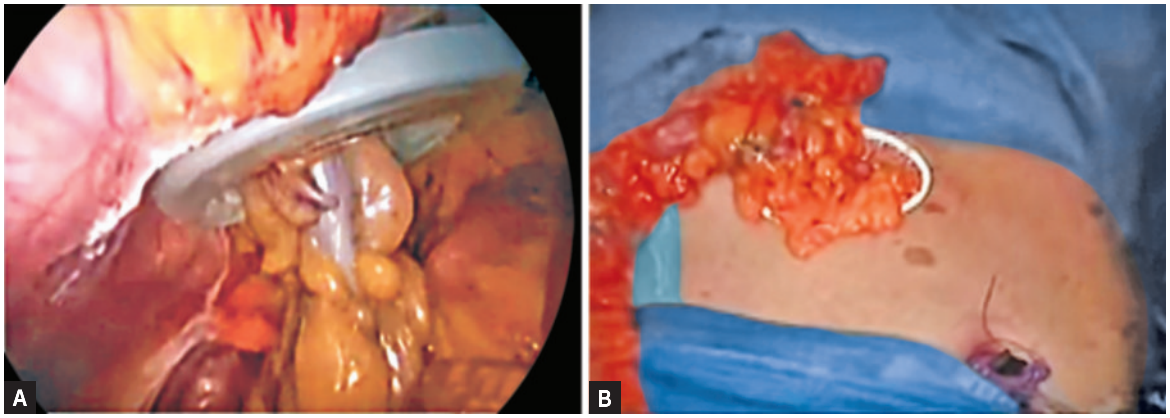


Fig. 29: Extraction of colon.

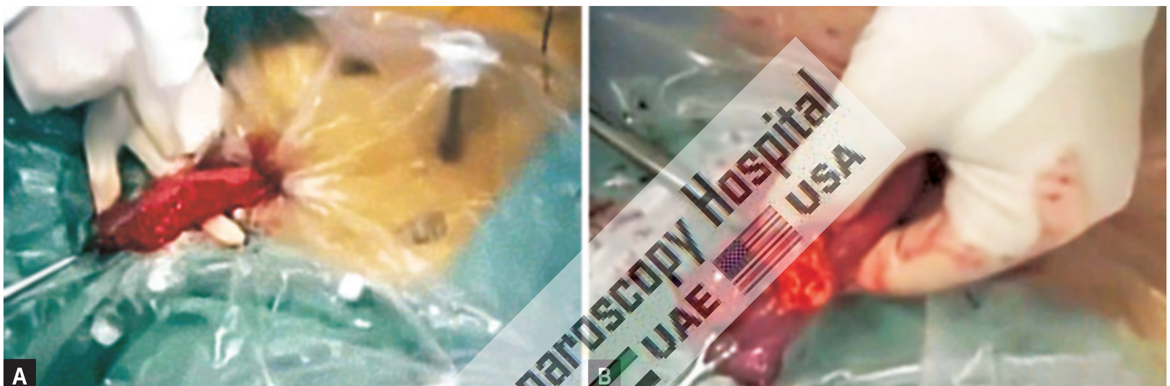
Wound Closure

The cannula sites are checked internally for possible hemorrhage. To do so, a grasper is passed through the cannula, and the cannula is removed, leaving the grasper in the abdomen. Because of the smaller diameter of the grasper compared with the cannula, if the bleeding was so far concealed by the tamponade effect of the cannula, it would be revealed promptly. The cannula is then reintroduced to allow maintenance of the pneumoperitoneum while performing the same check at all cannula sites.

When the check is completed, the CO_2 is desufflated through the cannulae, and cannulae are removed. No routine



Figs. 30A and B: Extraction of specimen through wound protector.



Figs. 31A and B: Preparation of the proximal loop of the colon for anastomosis.

drainage of the anastomotic area is performed. The suprapubic incision is closed in layers using running absorbable sutures, and all fascial defects of 10 mm and more are closed. The skin is closed with a subcuticular absorbable suture.

Sigmoidectomy for Diverticular Disease

The outcomes after laparoscopic sigmoidectomy for diverticulitis are similar or even better to those seen in the open method, with faster recovery and decreased postoperative pain. Hand-assisted laparoscopic sigmoid resection for diverticulitis is also an attractive alternative to a "pure" laparoscopic method in complicated cases.

The vascular approach for patients with benign diseases of the sigmoid colon is performed with the following steps.

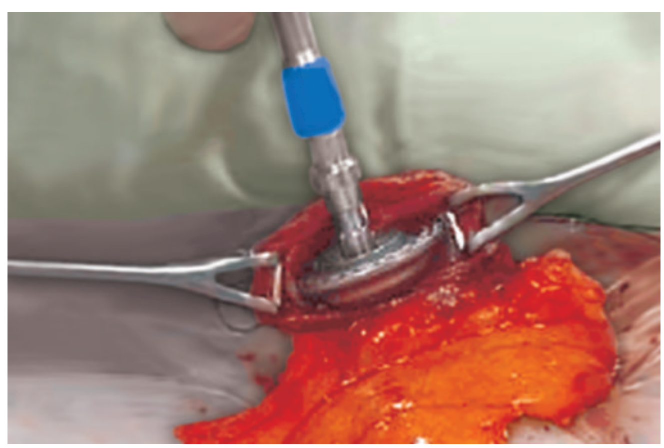


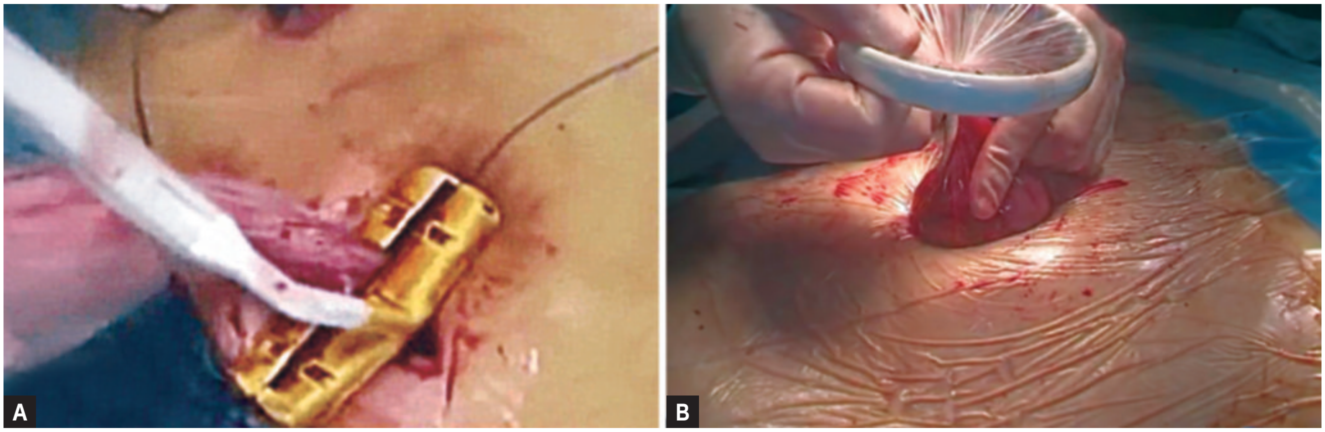
Fig. 32: Fixing the anvil on the proximal loop of colon.

Peritoneal Incision

The peritoneal incision can be similar to the cancer technique, particularly in difficult cases (obesity, inflammatory mesocolon). In most cases, the surgeon should try to preserve the vascularization of the rectum and the left colic vessels. The opening of the peritoneum can be limited to the mesosigmoid parallel to the colon at mid-distance between the colon and the root of the mesosigmoid. An initial lateral mobilization of the sigmoid can be useful in this approach. The branches of the sigmoid arterial trunk can be divided separately anteriorly to inferior mesenteric vessels or together after creating windows in the mesentery to divide the various branches. A linear stapler or, better, the LigaSure™ Atlas 10-mm device can be used for this task.

Resection of the Specimen

In diverticular disease, one should perform the distal resection of the bowel below the rectosigmoid junction.



Figs. 33A and B: Clamping and twisting of wound protector to prevent gas leak.

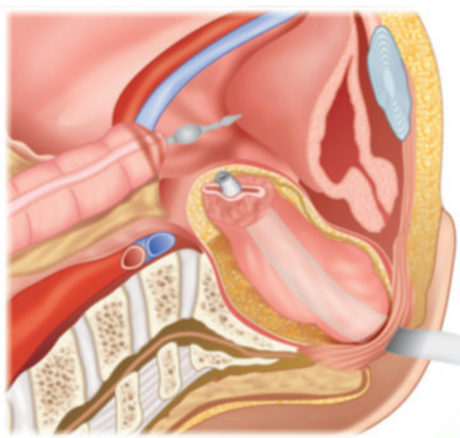


Fig. 34: Anvil and stapler ready for anastomosis.

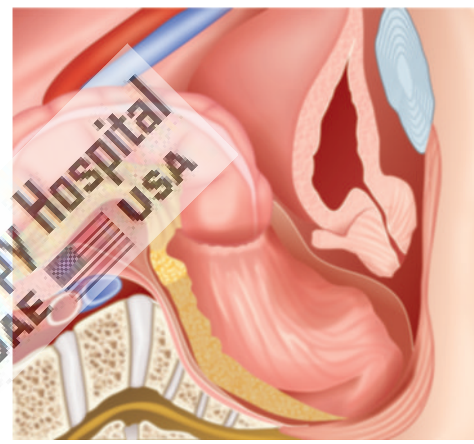


Fig. 35: End-to-end anastomosis done with the help of circular stapler.

The rectosigmoid junction is located just above the peritoneal reflection at the pouch of Douglas (**Fig. 37**). It is preferred to perform the mobilization of the splenic flexure at this moment, before resection at the proximal limit, using the same principles as described above.

Extraction of the Specimen

Before extracting the colon, it is important to divide the mesocolon at the level of the proximal side of the division. After adequate mobilization is achieved, the colon is extracted through a suprapubic incision, protected by the plastic drape described above, and proximal division performed externally on a compliant and well-vascularized part of the colon. The anastomosis is performed as described above for cancer.

Special Considerations

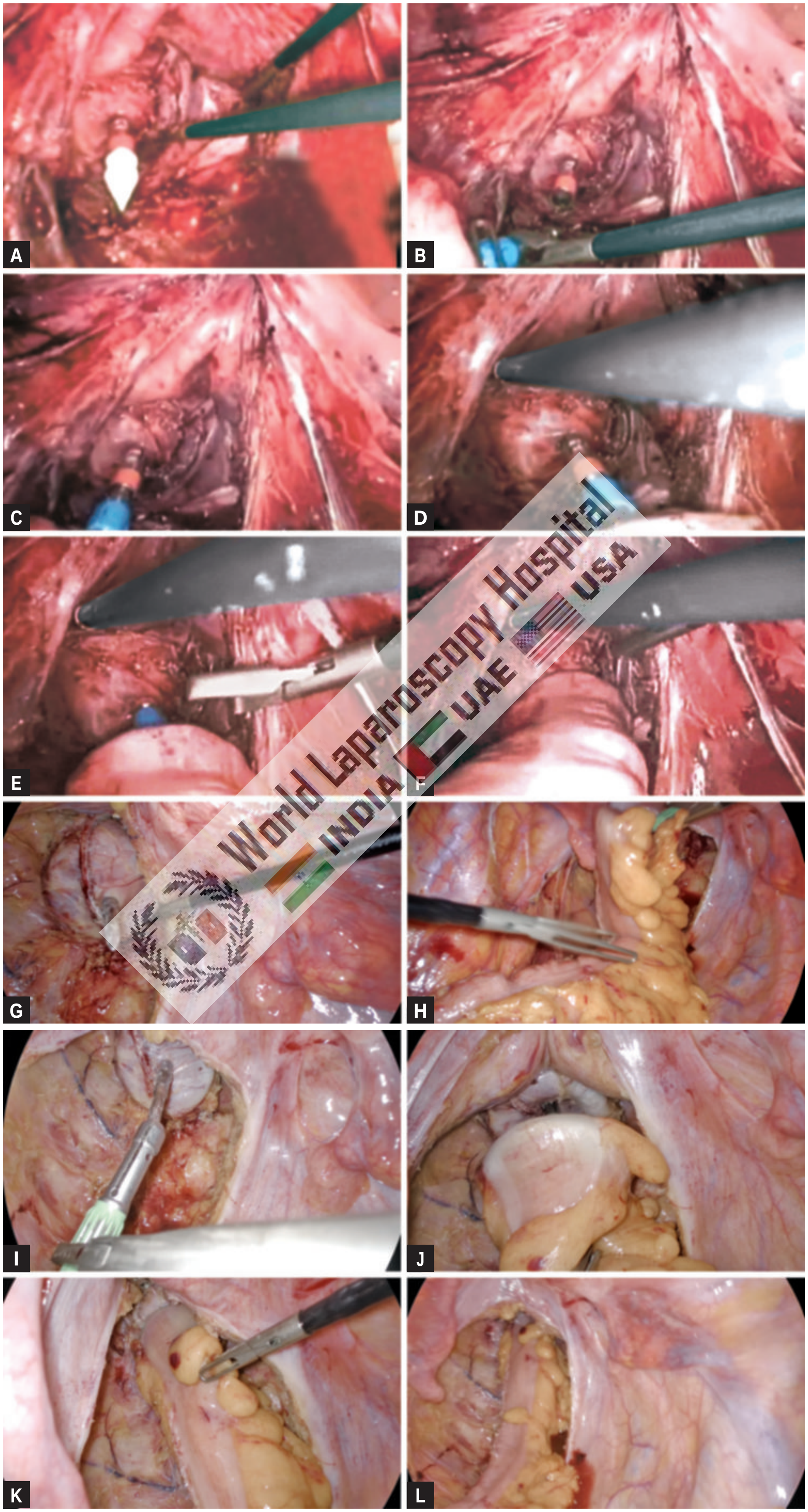
Ureteral injuries are one of the most important complications, which can be avoided by a perfect exposure and the respect of the correct plane of dissection. Indeed, a dissection properly performed above the Toldt's fascia does not expose the ureter to accidental injury. Difficult cases, such as important inflammatory reaction, cancer invasion or adhesions, and, sometimes, endometriosis, may alter the anatomy of the region and render the identification of the ureter troublesome. In these special cases, prevention of ureteral injury may be facilitated by the use of infrared wires inserted in ureteral stents. The infrared light is cold and safe for use in close contact with the ureteral tissue, and, on the other side, makes it easy to recognize the structure under the light of an adequate laparoscope.

LOW ANTERIOR RESECTION

Two surgical procedures with curative intent are available to patients with rectal cancer:

1. Lower anterior resection
2. Abdominoperineal resection

Lower anterior resection may improve quality of life and functional status. Lower anterior resection, formally known as anterior resection of the rectum and anterior excision of the rectum or simply anterior resection, is a common surgery for rectal cancer. It is commonly abbreviated as LAR. LAR is generally the preferred treatment for rectal cancer insofar as this is surgically feasible. Laparoscopic low anterior resection for rectal cancer has gained full acceptance among general surgeons. Hand-assisted laparoscopic surgery (HALS) LAR also has equal recognition, mainly due to the technical difficulties encountered during pelvic dissection.



Figs. 36A to L: Anastomosis by the help of a circular stapler.

Fig. 37: Before and after sigmoidectomy.

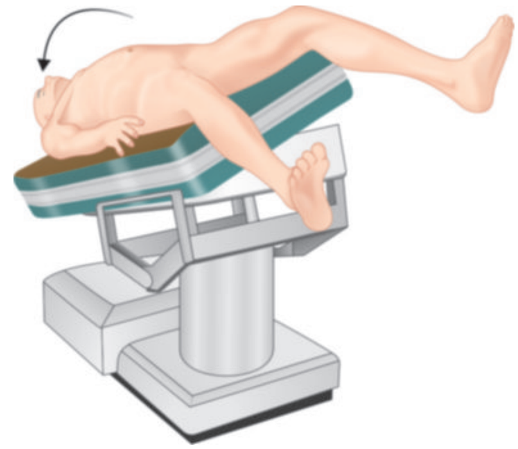


Fig. 38: Patient position for low anterior resection.

Patient Positioning

The patient is placed supine on the operating table **(Fig. 38)**. After induction of general anesthesia and insertion of an orogastric tube and Foley catheter, the legs are placed in stirrups. The arms are tucked at the patient's side, and the beanbag is aspirated. The abdomen is prepared with an antiseptic solution and draped routinely.

Position of Surgical Team

The primary monitor is placed on the left side of the patient at approximately the level of the hip. The operating nurse is placed between the patient’s legs. There should be sufficient space to allow the surgeon to move from either side of the patient to between the patient’s legs, if necessary. The primary operating surgeon stands on the right side of the patient with the assistant standing on the patient’s left and moving to the right side, caudad to the surgeon, once ports have been inserted **(Fig. 39)**. A 30-degree telescope is used.

Fig. 39: Position of the surgical team for LAR.
(LAR: low anterior resection)

Port Position

The primary optical port is introduced subumbilical using a modified Hasson approach. Having confirmed entry into the peritoneal cavity, a purse-string suture is placed around the subumbilical fascial defect, the abdomen to be insufflated with CO_2 to a pressure of 12 mm Hg.

The telescope is inserted into the abdomen and an initial diagnostic laparoscopy is performed, carefully evaluating the liver, small bowel, and peritoneal surfaces. A 12-mm port is inserted in the right lower quadrant approximately 2–3 cm medial and superior to the anterior superior iliac spine. It is carefully inserted lateral to the inferior epigastric vessels, paying attention to keep track of the port going as perpendicular as possible through the abdominal wall. A 5-mm port is then inserted in the right upper quadrant at least a hand’s breadth superior to the lower quadrant port. A left lower quadrant 5-mm port is inserted. A 5-mm left upper quadrant port is also inserted to aid splenic flexure mobilization. Again, all of these remaining ports are kept lateral to the epigastric vessels. This may be ensured by diligence to anatomic port site selection and using the laparoscope to transilluminate the abdominal wall before making the port-site incision to identify any obvious superficial vessels.

The assistant now moves to the patient’s left side, standing caudad to the surgeon. The patient is rotated with the left side up and right side down, to approximately 15–20° tilt, and often as far as the table can go. This helps to move the small bowel over to the right side of the abdomen. The patient is then placed in the Trendelenburg position. This again helps gravitational migration of the small bowel away from the operative field. The surgeon then inserts two atraumatic bowel clamps through the two right-sided abdominal ports. The greater omentum is reflected over the transverse colon so that it comes to lie on the stomach. If there is no space in the upper part of the abdomen, one must confirm that the orogastric tube is adequately decompressing the stomach. The small bowel is moved to the patient's right side, allowing visualization of the medial aspect of the rectosigmoid mesentery. This may necessitate the use of the assistant's 5-mm atraumatic bowel clamp through the left lower quadrant to tent the sigmoid mesentery cephalad.

Defining and Dividing the Inferior Mesenteric Pedicle

An atraumatic bowel clamp is placed on the rectosigmoid mesentery at the level of the sacral promontory, approximately halfway between the bowel wall and the promontory itself. This area is then stretched up toward the left lower quadrant port, stretching the inferior mesenteric vessels away from the retroperitoneum. In most cases, this demonstrates a groove between the right or medial side of the inferior mesenteric pedicle and the retroperitoneum. Electrosurgery or harmonic is used to open the peritoneum along this line, opening the plane cranially up to the origin of the inferior mesenteric artery, and caudally up to the sacral promontory. Blunt dissection is then used to lift the vessels away from the retroperitoneum and presacral autonomic nerves. The ureter is then looked for under the inferior mesenteric artery. If the ureter cannot be seen, and the dissection is in the correct plane, the ureter should be just deep to the parietal peritoneum, and just medial to the gonadal vessels. Care must be taken not to dissect too deep and injure the iliac vessels.

If the ureter cannot be found, it has usually been elevated on the back of the inferior mesenteric pedicle, and one needs to stay very close to the vessel not only to find the ureter but also to protect the autonomic nerves. If the ureter still cannot be found, the dissection needs to come in a cranial direction, which is usually into clean tissue allowing it to be found. If this fails, a lateral approach can be performed. This usually gives a fresh perspective to the tissues, and the ureter can often be found quite easily. In very rare cases, the ureter still may not be found. The ureteric stent should be used, and it helps in easy identification of ureter and prevents it from getting injured. It is good not to proceed if the ureter cannot be defined. The dissection is continued up to the origin of the inferior mesenteric artery, which is carefully defined and divided using a high ligation, above the left colic artery. A clamp is placed on the origin of the vessel to control it if clips or other energy sources do not adequately control the vessel. Endo Gia stapler can also be used for easy division of the vessel.

Having divided the vessels at the origin of the artery, the plane between the descending colon mesentery and the retroperitoneum is developed laterally, out toward the lateral attachment of the colon, and superiorly, dissecting the bowel off the anterior surface of the Gerota's fascia up toward the splenic flexure. This makes the inferior vein quite obvious, and this vessel can also be divided just inferior to the pancreas. This allows increased reach for a coloanal anastomosis with or without neorectal reservoir.

Mobilization of the Lateral Attachments of the Rectosigmoid and Descending Colon

The surgeon now grasps the rectosigmoid junction with his left-hand instrument and draws it to the patient's right side. This allows the lateral attachments of the sigmoid colon to be seen and divided using electrosurgery or harmonic.

Bruising from the prior retroperitoneal mobilization of the colon can usually be seen in this area. Once this layer of peritoneum has been opened, one immediately enters into the space opened by the retroperitoneal dissection. Dissection now continues up along the white line of Toldt, toward the splenic flexure. As the dissection continues, the surgeon's left-hand instrument needs to be gradually moved up along the descending colon to keep the lateral attachments under tension. In this way, the lateral and any remaining posterior attachments are freed, making the left colon and sigmoid a midline structure. Elevating the descending colon and drawing it medially is useful, as this keeps small bowel loops out of the way of the dissecting instrument and facilitates the dissection. In some patients, particularly very obese or otherwise large patients, it is difficult to reach high enough through the right lower quadrant port. For this reason, the surgeon's right-hand instrument is moved to the left lower quadrant port site. This permits greater reach along the descending colon.

Mobilization of the Splenic Flexure

Complete lateral mobilization of the left colon up to the splenic flexure is performed as an initial step. The descending colon is pulled medially using an atraumatic bowel clamp in the right lower quadrant port, and the scissors are placed in the left iliac fossa port. A 5-mm left upper quadrant port may be necessary, particularly in those with a very high splenic flexure, or in very tall or obese individuals. The lateral attachments of the left colon are divided, and the colon is dissected off the Gerota's fascia over the left kidney.

Once the lateral attachments of the colon have been freed, it is necessary to move medially and enter the lesser sac. Some surgeons prefer to perform this as an initial step before lateral mobilization. To enter the lesser sac, the patient is tilted to a slight reverse Trendelenburg position. An atraumatic bowel clamp is inserted through the right upper quadrant port. If the left upper quadrant port is available, this can also be used. The assistant holds up the greater omentum, toward its left side, like a cape. The surgeon grasps the transverse colon toward the left side using a grasper in the right lower quadrant port to aid the identification of the avascular plane between the greater omentum and the transverse mesocolon. Harmonic scalpel or monopolar scissors can be used through the left lower quadrant port to dissect this plane and enter the lesser sac. The surgeon usually moves to stand between the patient's legs for this part of the procedure. This dissection is continued toward the splenic flexure.

Following separation of the omentum off the left side of the transverse colon, connection to the lateral dissection allows the splenic flexure to be fully mobilized. The colon at the flexure is retracted caudally and medially, and any remaining restraining attachments are divided.

Rectal Mobilization

The patient is returned to the Trendelenburg position, and the small bowel is reflected cranially. Atraumatic bowel clamps inserted through the left-sided ports are used to elevate the rectosigmoid colon out of the pelvis and away from the retroperitoneum and sacral promontory, to enable entry into the presacral space. The posterior aspect of the mesorectum can be identified and the mesorectal plane dissected with diathermy, preserving the hypogastric nerves as they pass down into the pelvis, anterior to the sacrum. Dissection continues down the presacral space in this avascular plane toward the pelvic floor.

Attention is now switched to the peritoneum on the right side of the rectum. This is divided into the level of the seminal vesicles or rectovaginal septum. This is repeated on the peritoneum on the left side of the rectum. This facilitates further posterior dissection along the back of the mesorectum to the pelvic floor, to a level inferior to the lower edge of the mesorectum, just posterior to the anal canal. For an LAR, it is necessary to perform a total mesorectal excision and hence the rectum must be dissected down to the muscle tube of the rectum below the inferior extent of the mesorectum. In many cases, particularly in those who are obese or men with a narrow pelvis, some or all of the anterior and lateral dissection must be completed to get adequate visualization, to complete the posterior dissection.

An atraumatic bowel clamp through the left iliac fossa port is used to retract the peritoneum anterior to the rectum forward. The peritoneal dissection is continued from the free edge of the lateral peritoneal dissection, anteriorly. Lateral dissection is continued on both sides of the rectum and is extended anterior to the rectum, posterior to Denonvilliers' fascia, separating the posterior vaginal wall from the anterior wall of the rectum or down to the level of the prostate in men. The difficulty of dissection will vary depending on the body habitus of the patient, the diameter of the pelvis, and the size of the tumor. Occasionally, rectal mobilization can be very difficult to perform laparoscopically. In some cases, it may need to be completed in an open manner through a small Pfannenstiel incision.

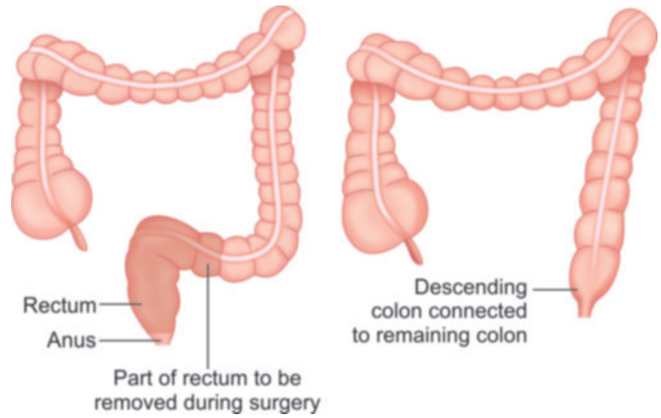


Fig. 40: Low anterior resection.

Division of Rectum

The lower rectum may be divided with a stapler either laparoscopically or by open surgery, depending on the ease of access related to the size of the pelvis **(Fig. 40)**. A rotaculator laparoscopic stapler may be used to divide the muscle tube of the rectum below the level of the mesorectum. The stapler is inserted through the right lower quadrant incision, and two firings of the stapler are usually required to divide the rectum. There is no residual mesorectum to divide at this level. A digital examination is performed to confirm the location of the distal staple line. If there is any doubt about the adequacy of the distal margin, a rigid proctoscopy is performed.

It is sometimes impossible to divide the rectum laparoscopically as the angulation of the endovascular stapler is limited to 45°, necessitating the open division of the rectum. In some patients, getting an assistant to push up on the perineum with their hand may lift the pelvic floor enough to get the first cartridge of the stapler low enough. In some cases, placing a suprapubic port allows easier access with the stapler to allow the division of the rectum.

Some patients are either too obese or have a very narrow pelvis or a long anal canal, and the stapler cannot be passed low enough. Two options exist. One is to perform a transanal intersphincteric dissection, remove the specimen, and then perform a handsewn coloanal anastomosis. The second is to perform a short Pfannenstiel incision, which allows a linear 30-mm stapler to be positioned and the rectum divided.

Extraction and Anastomosis

The specimen can be extracted either through a Pfannenstiel incision or a left iliac fossa incision; in both incisions, a wound protector is used in cases with a polyp or cancer to reduce the risk of tumor implantation in the wound. The left colon mesentery is divided with cautery. The left colon is divided, and the specimen is removed. Pulsatile mesenteric bleeding is confirmed and the vessels ligated with 0 polyglycolate suture ties. Depending on the preference of the operating surgeon, a colonic pouch or coloplasty may

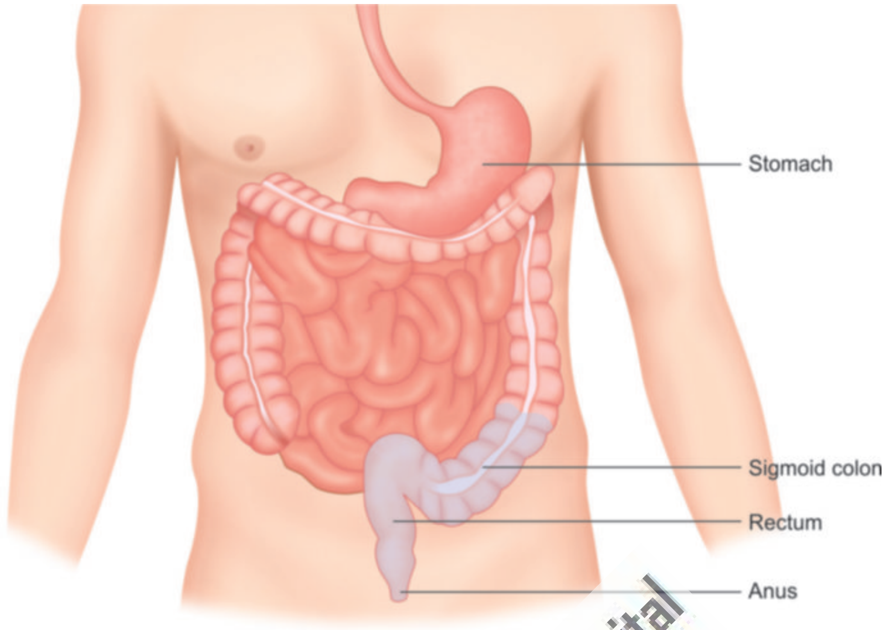


Fig. 41: Anus, rectum, and sigmoid colon removed in APR.
(APR: abdominoperineal resection)

be performed. A 2/0 Prolene purse-string suture is inserted into the distal end of the left colon or pouch, the anvil of a circular stapling gun inserted, and the purse-string suture is tied tightly. If a Pfannenstiel incision has been made, the coloanal anastomosis can be performed under direct vision and open manipulation following the insertion of a circular stapling gun into the rectal stump. If a left iliac fossa incision has been used, the colon is returned to the abdomen, and the incision closed, the pneumoperitoneum recreated, and the anastomosis is formed laparoscopically. The anastomosis can be leak-tested by filling the pelvis with saline and inflating the neorectum using a proctoscope or bulb syringe.

ABDOMINOPERINEAL RESECTION

Laparoscopic abdominoperineal resection is an operation in which the anus, rectum, and sigmoid colon are removed **(Fig. 41)**. It is used to treat cancer located very low in the rectum or in the anus, close to the sphincter muscles. Laparoscopic surgery for anorectal carcinoma is steadily gaining acceptance. The advantage offered by laparoscopy has always centered on improved vision. This advantage seems to be put to best use in the case of rectal cancer surgery, where logistic impediments, viz., narrow pelvis and impaired visibility as the dissection proceeds caudad, have proved to be obstacles to colorectal surgeons during open surgery. Recent studies have shown that the size of the tumor does not hamper the feasibility of performing laparoscopic abdominoperineal resection. We need to consider the possibility of an increased circumferential margin rate for large-size tumors. This may be addressed by preoperative radiotherapy and chemotherapy before undertaking surgery on these large tumors. It is important to note, though, that the oncological safety is not only dependant on the abdominal procedure but also the adequacy of the perineal part of the operation. Besides, should tumor injury be detected intraoperatively, it is advisable to convert to open surgery to control the amount of contamination and complete the rest of the procedure.

Patient Position

The patient is placed supine on the operating table on a beanbag. After induction of general anesthesia and insertion of an orogastric tube and Foley catheter, the legs are placed stirrups. The arms are tucked at the patient's side. The abdomen is prepared with an antiseptic solution and draped routinely.

Position of Surgical Team

The primary monitor is placed on the left side of the patient up toward the patient's feet. The secondary monitor is placed on the right side of the patient at the same level and is primarily for the assistant during the early phase of the surgery and port insertion. The operating nurse's instrument table is placed between the patient's legs. There should be sufficient space to allow the surgeon to move from either side of the patient to between the patient's legs, if necessary. The primary operating surgeon stands on the right side of the patient with the assistant standing on the patient's left and moving to the right side, caudad to the surgeon, once ports have been inserted.

Port Position

This is performed using a Hasson approach. A 10-mm smiling subumbilical incision is made. This is deepened down to the linea alba, which is then grasped on each side of the midline using Kocher clamps. A scalpel (No. 15 blades) is used to open the fascia between the Kocher clamps, and a Kelly forceps is used to open the peritoneum bluntly. Having confirmed entry into the peritoneal cavity, a purse-string suture of 0 polyglycolic acids is placed around the subumbilical fascial defect. A 10-mm reusable port is inserted through this port wound, allowing the abdomen to be insufflated with CO_2 to a pressure of 12 mm Hg. The laparoscope is inserted into the abdomen and an initial laparoscopy is performed, carefully evaluating the liver, small bowel, and peritoneal surfaces. A 12-mm port is inserted in the right lower quadrant approximately 2–3 cm medial and superior to the anterior superior iliac spine. This is carefully inserted lateral to the inferior epigastric vessels, paying attention to keep track of the port going as perpendicular as possible through the abdominal wall. A 5-mm port is then inserted in the right upper quadrant at least a hand's breadth superior to the lower quadrant port. A left lower quadrant 5-mm port is also inserted.

Exposure and Dissection of Retroperitoneum

The assistant now moves to the patient's left side, standing caudad to the surgeon. The patient is rotated with the left side up and right side down, to approximately 15–20° tilt, and often as far as the table can go. This helps to move the small bowel over to the right side of the abdomen. The patient is then placed in the Trendelenburg position. This again helps gravitational migration of the small bowel away from the operative field. The surgeon then inserts two atraumatic bowel clamps through the two right-sided abdominal ports. The greater omentum is reflected over the transverse colon so that it comes to lie on the stomach. If there is no space in the upper part of the abdomen, one must confirm that the orogastric tube is adequately decompressing the stomach. The small bowel is moved to the patient's right side, allowing visualization of the medial aspect of the rectosigmoid mesentery pedicle. This may necessitate the use of the assistant's 5-mm atraumatic bowel clamp through the left lower quadrant to tent the sigmoid mesentery cephalad. Complete mobilization of the left colon is not required. Adequate mobilization must allow the formation of a left iliac fossa colostomy without tension. Following the division of the inferior mesenteric artery, the left mesocolon is separated from the retroperitoneum in a medial-to-lateral direction using a spreading movement. An atraumatic bowel clamp inserted through a right-sided port is placed under the left colonic mesentery, which is elevated away from the retroperitoneum, and using a scissors inserted through the other right-sided port, the attachments to the retroperitoneum are swept down, until the lateral abdominal wall is reached.

Division of the Left Colon

The mesentery of the left colon is divided from the free edge, cranial to the previously divided inferior mesenteric artery, toward the left sigmoid colon. The mesentery can be divided with diathermy, and the marginal artery can be clipped and then divided. Alternatively, an energy source such as a LigaSure™ may be used to divide the mesentery up to the edge of the bowel. This may be done before freeing the lateral attachments of the sigmoid and left colon as it aids in retraction.

After the division of the mesentery, the lateral attachments of the sigmoid to the abdominal wall are divided along the white line. Care is taken to avoid damage to the retroperitoneal structures. The colon is then divided using a linear endoscopic stapler at the site where the colonic mesentery has been divided.

Rectal Mobilization

In women, the uterus may be hitched out of the area of dissection with a suture. Atraumatic bowel clamps that are inserted through the left-sided ports are used to elevate the rectosigmoid colon out of the pelvis and away from the retroperitoneum and sacral promontory, to enable entry into the presacral space. The posterior aspect of the mesorectum can be identified and the mesorectal plane dissected with diathermy, preserving the hypogastric nerves passing down into the pelvis anterior to the sacrum. Dissection continues down the presacral space in this avascular plane toward the pelvic floor. Attention is now switched to the peritoneum on the right side of the rectum. This is divided to the level of the seminal vesicles or rectovaginal septum. This is repeated on the peritoneum on the left side of the rectum. This facilitates further posterior dissection along the back of the mesorectum to the pelvic floor, to a level inferior to the lower edge of the mesorectum. Usually, when the approach is low on the posterior surface of the mesorectum, it becomes necessary to perform a lateral and anterior dissection.

A bowel grasper inserted through the left iliac fossa port is used to retract the peritoneum anterior to the rectum forward. The peritoneal dissection is continued from the free edge of the lateral peritoneal dissection, anteriorly. Lateral dissection is continued on both sides of the rectum. It is extended anteriorly to the rectum in front of Denonvilliers' fascia, separating the posterior vaginal wall from the anterior wall of the rectum or down past the level of the prostate in men. The most inferior rectal dissection can be completed from the perineal approach. For anterior tumors, the dissection may be performed anterior to Denonvilliers' fascia, or by taking one side of the fascia to protect the anterolateral nerve bundle.

It is necessary to perform a total mesorectal excision and hence the rectum must be dissected down close to the muscle tube of the rectum below the level of the mesorectum.

The levators may then be divided from above, staying well wide of any potential tumor, or the division may be performed from below after making the perineal incision.

Formation of Trephine Left Iliac Fossa Colostomy

The divided distal end of the left sigmoid colon is grasped with atraumatic bowel clamps, which are locked. A trephine colostomy is made in the left iliac fossa at a site that has been marked by an enterostomal therapist before surgery. A skin disk is excised, and a longitudinal incision is made in the anterior rectus sheath, and the left rectus muscle is split. The peritoneum is held with two hemostats and incised. The stapled colon is delivered to the trephine and grasped with Babcock forceps and delivered through the trephine.

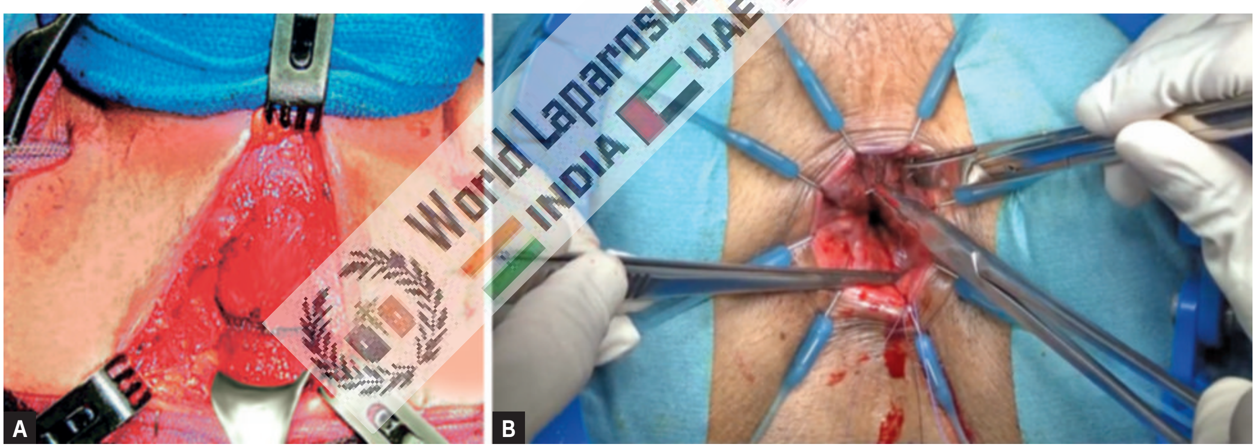
The staple line is excised, and the end colostomy is matured using 3/0 chromic catgut sutures.

Perineal Dissection

The perineal dissection is performed with a conventional open approach **(Figs. 42A and B)**. The anus is sutured closed with 0 nylon, and an elliptical skin incision is made. The incision is deepened using diathermy, and the ischiorectal fossae are entered on either side, well lateral to the external sphincter muscle. The dissection continues laterally and posteriorly to expose the levator ani muscles **(Fig. 43)**. The tip of the coccyx is used as the posterior landmark, and the pelvic cavity is entered by dividing the levator ani muscle just anterior to the tip of the coccyx. A finger can be placed into the pelvis onto the upper border of the levator ani, which is divided with diathermy onto the underlying finger. Care is taken anteriorly to divide the remaining levator ani while protecting the posterior surface of the vagina or prostate/urethra. The specimen may then be delivered out of the pelvis, which facilitates the division of the remaining anterior attachments of the rectum, reducing the risk of damage to the prostate or posterior wall of the vagina. The specimen is removed, the pelvic cavity irrigated of blood or debris, and the perineal tissue closed in layers using polydioxanone sutures.

HARTMANN REVERSAL

The Hartmann procedure is a standard life-saving operation for acute left colonic complications. It is usually performed



Figs. 42A and B: Perineal dissection.

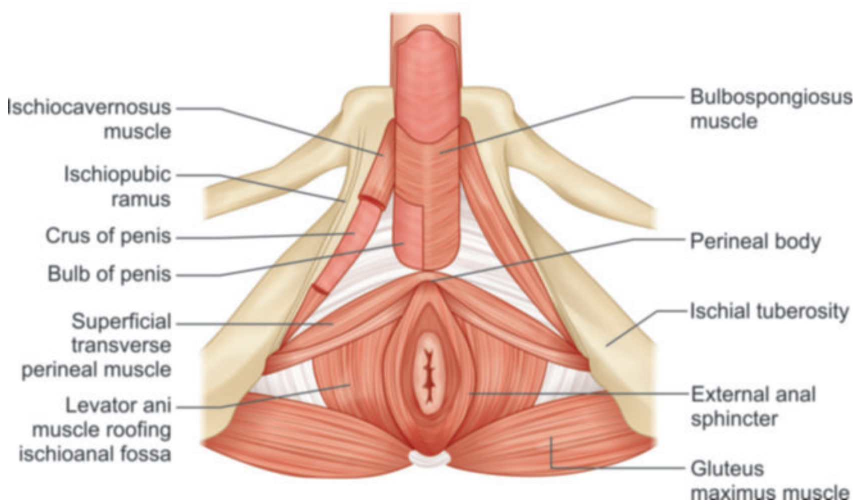


Fig. 43: Perineal anatomy.

as a temporary procedure with the intent to reverse it later on. This reversal is associated with considerable morbidity and mortality by the open method. The laparoscopic reestablishment of intestinal continuity after Hartmann procedure has shown better results in terms of a decrease in morbidity and mortality.

There are several laparoscopic techniques of the reversal of the Hartmann procedure. The principle common to all techniques is a tension-free intracorporeal stapler anastomosis. The introduction of a circular stapler in the rectal stump helps in the identification and mobilization of the rectal stump. Others have mobilized the colostomy first and have used the colostomy site as a first port or used a standard umbilical port.

It is technically challenging and requires an experienced laparoscopic surgeon but offers clear advantages to patients. Main reasons reported for conversion to open were dense abdominal–pelvic adhesions secondary to diffuse peritonitis at the primary operation, the short delay before the reconstruction, difficulty in finding the rectal stump, and rectal scarring. Leaving long, nonabsorbable suture ends at the rectal stump or suturing it to the anterior abdominal wall helps in its localization. Other relative limitation factors could be a large incisional hernia from the previous laparotomy and contraindications to general anesthesia and laparoscopy.

Patient Position

The patient is placed supine on the operating table, on a beanbag. After induction of general anesthesia and insertion of an orogastric tube and Foley catheter, the legs are placed in a lithotomy stirrup position. The arms are tucked at the patient's side, and the beanbag is aspirated.

The abdomen is prepared with an antiseptic solution and draped routinely.

Position of Surgical Team

The primary monitor is placed on the left side of the patient at approximately the level of the hip. The secondary monitor is placed on the right side of the patient at the same level and is primarily for the assistant during the early phase of the surgery and port insertion. The operating nurse's instrument table is placed between the patient's legs. There should be sufficient space to allow the surgeon to move from either side of the patient to between the patient's legs, if necessary. The primary operating surgeon stands on the right side of the patient with the assistant standing on the patient's left and moving to the right side, caudad to the surgeon once ports have been inserted. A 30-degree camera lens is better to be used.

The colostomy is mobilized and all adhesions dissected through the fascial opening until an adequate segment of bowel has been freed from the surrounding tissues. The bowel is trimmed as necessary, and a purse-string suture is positioned before insertion of the anvil of a curved EEA stapling device. The bowel is returned to the abdomen, the fascia is closed with a monofilament suture, but before tying the suture a 12-mm port is inserted at this site, and the abdomen is insufflated.

The laparoscope is inserted into the abdomen through the stoma port to assess adhesions and allow direct visualization for subsequent port insertion, and an initial laparoscopy is performed, carefully evaluating the liver, small bowel, and peritoneal surfaces. A 10-mm port is inserted in the umbilicus for camera location. A 5-mm right lower quadrant trocar is placed approximately 2–3 cm medial to the anterior superior iliac spine. This is carefully inserted lateral to the inferior epigastric vessels, paying attention to keep track of the port going as perpendicular as possible through the abdominal wall. A 5-mm port is then inserted in the right upper quadrant at least a hand's breadth superior to the lower quadrant port. A left upper quadrant 5-mm port is inserted. Again all of these remaining ports are kept lateral to the epigastric vessels. This may be ensured by diligence to anatomic port site selection and using the laparoscope to transilluminate the abdominal wall before making the port-site incision to identify any obvious superficial vessels.

The assistant now moves to the patient's right side, standing caudad to the surgeon. The patient is rotated with the left side up and right side down, to approximately 15–20° degrees tilt, and often as far as the table can go. This helps to move the small bowel over to the right side of the abdomen. The patient is then placed in the Trendelenburg position. This again helps gravitational migration of the small bowel away from the operative field. The surgeon then inserts two atraumatic bowel clamps through the two right-sided abdominal ports. The greater omentum is reflected over the transverse colon so that it comes to lie on the stomach. If there is no space in the upper part of the abdomen, one must confirm that the orogastric tube is adequately decompressing the stomach. The small bowel is moved to the patient's right side, allowing visualization of the proximal rectum. Variable degrees of adhesiolysis may be required. This may necessitate the use of the assistant's 5-mm atraumatic bowel clamp through the stoma trocar or left upper quadrant.

Left Colon Mobilization

An atraumatic bowel clamp is placed on the descending colon to take down the inflammatory and native attachments to free it laterally. The omentum is dissected off the transverse colon, and the lesser sac is entered. The splenic flexure is released to allow a tension-free reach to the proximal rectum. The colonic mesentery should be mobilized off the Gerota's fascia. The left ureter is identified at the pelvic brim and freed from the proximal rectum to avoid injury. The ureter should be just deep to the parietal peritoneum, and just medial and posterior to the gonadal vessels. Care must be taken not to dissect too deep or caudad, leading to injury of the iliac vessels.

Mobilization of Rectum

An atraumatic bowel clamp inserted through the left lower quadrant port is used to elevate the proximal rectum out of the pelvis and away from the retroperitoneum and sacral promontory, to enable entry into the presacral space. The posterior aspect of the mesorectum can be identified and the mesorectal plane dissected with diathermy, preserving the hypogastric nerves as they pass down into the pelvis anterior to the sacrum. Dissection needs to progress only to allow the advancement of the circular stapler to the end of the rectum and assure that all the sigmoid has been resected. If residual sigmoid is present, the linear endoscopic stapler should be used to divide the bowel at the level of the proximal rectum. A site for rectal division should be chosen in proximal, peritonealized rectum, which assures that the anastomosis will be distal to the sacral promontory. The rectum is divided laparoscopically with a linear endoscopic stapler through the right lower quadrant trocar. One or two firings of the stapler may be required to divide the rectum. The mesorectum is divided using monopolar and bipolar cautery at this level.

Specimen Extraction and Anastomosis

If residual sigmoid is required, the specimen is extracted through the stoma site port. Pneumoperitoneum is recreated, and the circular stapled anastomosis is formed under laparoscopic guidance. The anastomosis can be leak-tested by filling the pelvis with saline and inflating the neorectum using a proctoscope or bulb syringe, and the orientation and lack of tension confirmed. The fascia of all the 10 mm or above port is closed, and the usual manner is followed for skin dressing.

Conclusion

The reversal of the Hartmann procedure can be difficult due tendency of the Hartmann segment to become densely adherent deep in the pelvis. The laparoscopic reversal has made this major operation easier, safe, and practical. As a majority of these patients is in the elderly age group, it has the advantage of early mobilization, less pain, short hospital stay, and returns to normal life.

RESECTION RECTOPEXY

Total rectal prolapse with chronic constipation and anal incontinence is a devastating disorder. It is more common in the elderly, especially women, although why it happens is unclear. Rectal prolapse can cause complications (such as pain, ulcers, and bleeding), and cause fecal incontinence **(Figs. 44A to C)**. Surgery is commonly used to repair the prolapse. Rectopexy with or without bowel resection is the most frequent surgical procedure, with 0–9% recurrence rates in many years. Laparoscopic resection rectopexy is safely feasible as a minimally invasive treatment option for rectal prolapse.

Patient Position

The patient is placed supine on the operating table, on a beanbag. After induction of general anesthesia and insertion of an orogastric tube and Foley catheter, the legs are placed in Dan Allen stirrups. The arms are tucked at the patient's side. The abdomen is prepared with an antiseptic solution and draped routinely.

Position of Surgical Team

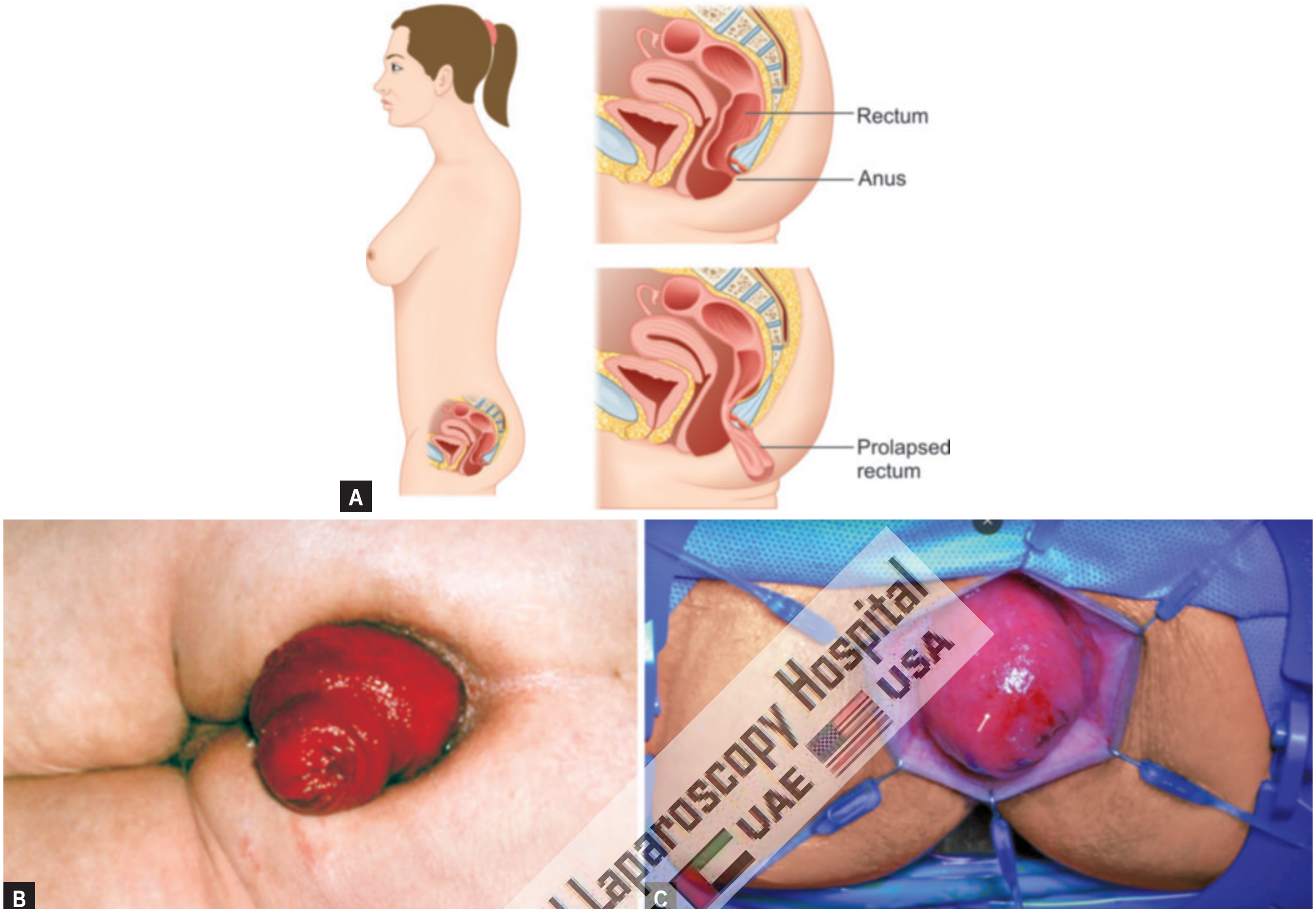
The primary monitor is placed on the left side of the patient at approximately the level of the hip. The secondary monitor is placed on the right side of the patient at the same level and is primarily for the assistant during the early phase of the surgery and port insertion. The operating nurse's instrument table is placed between the patient's legs. There should be sufficient space to allow the surgeon to move from either side of the patient to between the patient's legs, if necessary. The primary operating surgeon stands on the right side of the patient with the assistant standing on the patient's left and moving to the right side, caudad to the surgeon once ports have been inserted. A 0-degree camera lens is used.

Port Position

This is performed using a Hasson approach. A smiling 10-mm subumbilical incision is made. This is deepened down to the linea alba, which is then grasped on each side of the midline using Kocher clamps. A scalpel (No. 15 blades) is used to open the fascia between the Kocher clamps, and a Kelly forceps is used to open the peritoneum bluntly. The telescope is inserted into the abdomen, and an initial laparoscopy is performed, carefully evaluating the liver, small bowel, and peritoneal surfaces. A 12-mm port is inserted in the right lower quadrant approximately 2–3 cm medial and superior to the anterior superior iliac spine. This is carefully inserted lateral to the inferior epigastric vessels, paying attention to keep track of the port going as perpendicular as possible through the abdominal wall. A 5-mm port is then inserted in the right upper quadrant at least a hand's breadth superior to the lower quadrant port. A left lower quadrant 5-mm port is inserted. All the ports are more or less obeying the baseball diamond concept.

Dissection

The patient is rotated with the left side up and right side down, to approximately 15–20° tilt, and often as far as the table can go. This helps to move the small bowel over to



Figs. 44A to C: Rectal prolapse

the right side of the abdomen. The patient is then placed in the Trendelenburg position. This again helps gravitational migration of the small bowel away from the operative field. The surgeon then inserts two atraumatic bowel clamps through the two right-sided abdominal ports. The greater omentum is reflected over the transverse colon so that it comes to lie on the stomach. If there is no space in the upper part of the abdomen, one must confirm that the orogastric tube is adequately decompressing the stomach. The small bowel is moved to the patient's right side, allowing visualization of the medial aspect of the rectosigmoid mesentery. This may necessitate the use of the assistant's 5-mm atraumatic bowel clamp through the left lower quadrant to tent the sigmoid mesentery cephalad.

Division of Inferior Mesenteric Vessel

An atraumatic bowel clamp is placed on the rectosigmoid mesentery at the level of the sacral promontory, approximately halfway between the bowel wall and the promontory itself. This area is then stretched up toward the left lower quadrant port, stretching the inferior mesenteric vessels away from the retroperitoneum. In most cases, this demonstrates a groove between the right or medial side of the inferior mesenteric pedicle and the retroperitoneum. Cautery is used to open the peritoneum along this line, opening the plane cranially up to the origin of the inferior mesenteric artery, and caudally past the sacral promontory. Blunt dissection is then used to lift the vessels away from the retroperitoneum and presacral autonomic nerves. The ureter is then looked for under the inferior mesenteric artery. If the ureter cannot be seen, and the dissection is in the correct plane, the ureter should be just deep to the parietal peritoneum, and just medial to the gonadal vessels. Care must be taken not to dissect too deep or caudad, leading to injury of the iliac vessels.

If the ureter cannot be found, it has usually been elevated on the back of the inferior mesenteric pedicle, and one needs to stay very close to the vessel not only to find the ureter but also to protect the autonomic nerves. If the ureter still cannot be found, the dissection needs to come in as a cranial dissection, which is usually into clean tissue allowing it to be found. If this fails, a lateral approach can be performed. This usually gives a fresh perspective to the tissues, and the ureter can often be found quite easily. In very rare cases, the ureter still may not be found.

The dissection should allow sufficient mobilization of the IMA so that the origin of the left colic artery is seen. The vessel is carefully defined and divided just distal to the left colic artery. A clamp is placed on the origin of the vessel to control it if clips or other energy sources do not adequately control the vessel. In general, a cartridge of the endoscopic linear stapler is used to divide the vessel. Having divided the pedicle, the plane between the sigmoid colon mesentery and the retroperitoneum is developed laterally, out toward the lateral attachment of the colon. Limited mobilization of the mesentery of the anterior surface of Gerota's fascia and of the left colon should be performed to enhance the fixation of the rectum.

Mobilization of the Lateral Attachments of the Rectosigmoid

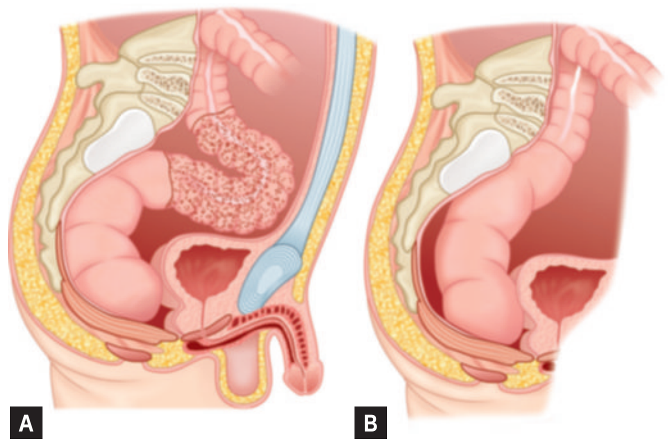
The surgeon now grasps the rectosigmoid junction with his left-hand instrument and draws it to the patient's right side. This allows the lateral attachments of the sigmoid colon to be seen and divided using cautery. Bruising from the prior retroperitoneal mobilization of the colon can usually be seen in this area. Once this layer of peritoneum has been opened, one immediately enters into the space opened by the retroperitoneal dissection. No dissection should be performed more proximally along the white line of Toldt, toward the splenic flexure.

Mobilization of Rectum

An atraumatic bowel clamp inserted through the left lower quadrant port is used to elevate the rectosigmoid colon out of the pelvis and away from the retroperitoneum and sacral promontory, to enable entry into the presacral space. The posterior aspect of the mesorectum can be identified, and the mesorectal plane dissected with diathermy, preserving the hypogastric nerves as they pass down into the pelvis anterior to the sacrum. Dissection continues down the presacral space in this avascular plane toward the pelvic floor. Only the posterior 60% of the rectum needs to be mobilized; however, dissection should be continued all the way to the levator ani muscles. A transanal examining finger should be used to confirm the distal extent of the dissection. The lateral stalks should be preserved. The peritoneum on either side of the rectum should be incised to the level of the lateral stalks. The lateral stalks should generally be preserved, the exception being when further dissection must completely reduce a very distal prolapsing segment.

Rectal Division

The fully mobilized rectum should be elevated out of the pelvis and a site selected for optimal rectal tension to maintain a full reduction of the prolapse. A site for rectal division should be chosen in proximal, peritonealized rectum, which assures that the anastomosis will be rostral to the sacral promontory. The rectum is divided laparoscopically with a linear endoscopic stapler through the right lower quadrant trocar. One or two firings of the stapler may be required to divide



Figs. 45A and B: Resection rectopexy.

the rectum. The mesorectum is divided using monopolar and bipolar cautery at this level.

Specimen Extraction and Anastomosis

The specimen is extracted through a left iliac fossa incision. Before making the incision, the proximal colonic transaction point should be grasped with a locking atraumatic bowel grasper. This site should allow a colorectal anastomosis that will provide a safe amount of tension on the rectum to maintain prolapse reduction. After extracorporeal bowel transaction, adequate vascularity of the colon should be assured. A 2/0 Prolene purse-string suture is inserted into the distal end of the left colon; the anvil of a circular stapling gun is inserted, and the purse-string suture is tied tightly. The colon is returned to the abdomen, and the left iliac fossa incision is closed in layers with 0 polyglycolic acid suture. Pneumoperitoneum is recreated, and the circular stapled anastomosis is formed under laparoscopic guidance. The anastomosis can be leak-tested by filling the pelvis with saline and inflating the neorectum using a proctoscope or bulb syringe.

Rectopexy (Figs. 45A and B)

The rectum is retracted rostrally to the desired tension to allow complete reduction of the prolapse. The rectopexy is then performed from the right side using the two remaining ports. Two or three nonabsorbable sutures are used to attach the mesorectum distal to the anastomosis to the sacral promontory. Alternatively, nitinol or titanium tackers may be employed using one of the mechanical fixation devices used for mesh hernia repairs.

WELLS OR MARLEX RECTOPEXY

Rectal prolapse is a distressing condition, especially when associated with fecal incontinence and constipation. It usually occurs in children or the elderly. Presently laparoscopic approach is favored as it has better results, especially in terms of less postoperative pain, shorter hospital stay, and lower cost. The pelvic sympathetic and parasympathetic nerves run along with the rectum; if dissection is not carried out in the proper plane, injury can occur, leading to bladder dysfunction, impotence, and retrograde ejaculation. This is an important consideration when trying to decide which procedure to perform, especially in men, although the risk of injury should be <1–2%. Perineal procedures and anterior resection have a low risk of outlet obstruction. Abdominal procedures of rectopexy that tack the rectum to the sacrum can cause outlet obstruction if the rectum is wrapped circumferentially, often requiring the release of the fixation to treat the problem.

In a Marlex rectopexy (Ripstein procedure), the entire rectum is mobilized down to the coccyx posteriorly, the lateral ligaments laterally, and the anterior cul-de-sac anteriorly. A nonabsorbable material, such as Marlex mesh or an Ivalon sponge, is then fixed to the presacral fascia. The rectum is then placed on tension, and the material is partially wrapped around the rectum to keep it in position. The anterior wall of the rectum is not covered with the sponge or mesh in order to prevent a circumferential obstruction. The peritoneal reflections are then closed to cover the foreign body. The Marlex mesh or sponge causes an inflammatory reaction that scars and fixes the rectum into place.

The Wells procedure was followed by rectal dysfunction accompanied by increased constipation and evacuation problems. The Ripstein procedure, preserving the lateral ligaments, appears not to affect such symptoms adversely. Modified mesh rectopexy aligns the rectum, avoids excessive mobilization and division of lateral ligaments, thus preventing constipation and preserving potency. We recommend this technique for patients with complete rectal prolapse with up to grades 1, 2, and 3 incontinence based on Browning and Parks classification.

During wells rectopexy, the dissection should allow sufficient mobilization of the IMA so that the origin of the left colic artery is seen. The pedicle is not divided.

The plane between the sigmoid colon mesentery and the retroperitoneum is developed laterally, out toward the lateral attachment of the colon. Limited mobilization of the mesentery of the anterior surface of Gerota's fascia and of the left colon should be performed to enhance the fixation of the rectum.

Ripstein operation often improved anal continence in patients with rectal prolapse and rectal intussusception. This improvement was accompanied by increased maximum resting pressure (MRP) in patients with rectal prolapse, indicating recovery of internal anal sphincter function. In one of the studies at the Department of Surgery, Karolinska Institute at Danderyd Hospital, Stockholm, Sweden, MRP (52+/– 23 mm Hg) was found in patients with rectal prolapse who underwent Ripstein operation than in patients with rectal intussusception. No postoperative increase in MRP was found in patients with rectal intussusception. This suggests an alternate mechanism of improvement in patients with rectal intussusception.

Mobilization of the Lateral Attachments of the Rectosigmoid

For rectal prolapse surgery lateral mobilization, the surgeon grasps the rectosigmoid junction with his left-hand instrument and draws it to the patient's right side. This allows the lateral attachments of the sigmoid colon to be seen and divided using cautery. Bruising from the prior retroperitoneal mobilization of the colon can usually be seen in this area. Once this layer of peritoneum has been opened, one immediately enters into the space opened by the retroperitoneal dissection. No dissection should be performed more proximally along the white line of Toldt, toward the splenic flexure.

Rectal Mobilization

An atraumatic bowel clamp inserted through the left lower quadrant port is used to elevate the rectosigmoid colon out of the pelvis and away from the retroperitoneum and sacral promontory, to enable entry into the presacral space. The posterior aspect of the mesorectum can be identified, and the mesorectal plane dissected with diathermy, preserving the hypogastric nerves as they pass down into the pelvis anterior to the sacrum. Dissection continues down the presacral space in this avascular plane toward the pelvic floor. Only the posterior 60% of the rectum needs to be mobilized; however, dissection should be continued all the way to the levator ani muscles. A transanal examining finger should be used to confirm the distal extent of the dissection. The peritoneum on either side of the rectum should be incised to the level of the lateral stalks. The lateral stalks should generally be preserved, the exception being when further dissection must completely reduce a very distal prolapsing segment. The rectum is not divided in the case of Wells rectopexy.

Rectopexy

A 2–4 cm portion of polypropylene mesh is rolled and inserted through the umbilical trocar. The camera is reinserted, and the mesh is positioned at the sacral promontory. A mechanical device used for hernia mesh fixation is used to fix the mesh to the promontory. This may be inserted through the right lower quadrant port, but if adequate access cannot be obtained, a 5-mm suprapubic port may be inserted. Great care must be taken not to tear or strip off the presacral fascia when stapling the mesh in place.

The rectum is retracted rostrally to the desired tension to allow complete reduction of the prolapse, which is confirmed by digital rectal examination. The rectopexy is then performed from the right side using the two right-sided trocars. Two or three nonabsorbable sutures are used to attach the distal mesorectum to the mesh at the promontory, sufficient to maintain adequate tension. Alternatively, the mechanical fixation device used for mesh fixation may be employed.

The Complications of Colorectal Surgery

The exact frequency and severity of complications are difficult to determine due to heterogeneous definitions, patient populations, procedures, comorbidities, and intensity of follow-up. One perspective of the incidence of complications can be gleaned from four recent randomized controlled trials comparing laparoscopic to open colon resections for cancer **(Table 1)**.

The risk factors related to colorectal surgery include:

- Perioperative blood transfusion
- American Society of Anesthesiology (ASA) score grade 2 or 3
- Male gender
- Surgeons
- Types of operation
- Creation of an ostomy
- Contaminated wound
- Use of a drain
- Obesity
- Long duration of operation

Wound Infection

Superficial wound infections are the most common complication of colorectal surgery. The previously held belief that preoperative cathartic and oral antibiotic bowel preparation was mandatory to prevent postoperative infections has recently been debunked by multiple randomized controlled trials. Superficial wound infections are recognized by any combination of erythema, induration, tenderness, or drainage at the wound site. Systemic signs of fever and tachycardia may also be present. The infection may manifest as an abscess, cellulitis, or a combination of the two. When suspected, the wound should be carefully inspected, and when a collection is detected, it is drained by reopening the wound. Gram stain can assist in the management and antibiotic selection.

Anastomotic Leak

During laparoscopic colorectal surgery, the anastomotic leak is a common, potentially life-threatening complication associated with significant morbidity, increased risk of local recurrence of cancer, decreased functional outcomes, increased length of stay, high risk of (permanent) ostomy, and death. Leaks are variably defined in the literature, but in general, regarded as perianastomotic stool, gas, or abscess, peritonitis, or a fecal fistula. The incidence of an anastomotic leak following colectomy is generally reported between 2 and 6%. Anastomotic leaks present in one of three ways:

1. Asymptomatic leak
2. Subtle, insidious leak
3. Dramatic early leak

After surgery, the asymptomatic leak is incidentally found during endoscopic or radiographic studies. The incidence of radiographically detected leaks is 4–6 times higher than clinically detected leaks. These leaks, which often present weeks or months later, are typically walled off sinuses, and are, as a general rule, harmless. Treatment is rarely necessary. The subtle, insidious leak can present perioperatively with nonspecific signs and symptoms common in the postoperative period. Such signs include low-grade fevers, mild leukocytosis, protracted ileus, and failure to thrive and occur 5–14 days following surgery. Management of the stable patient without signs of peritonitis usually begins with imaging to identify and localize the process. Traditionally, water-soluble contrast enema has been the primary study to identify leaks. Drawbacks include lower sensitivity for right-sided anastomosis as the contrast dilutes out before reaching the proximal bowel. It also provides little information on extracolonic conditions such as ileus and collections.

TABLE 1: Complication rates following laparoscopic and open colon resections.

	Barcelona trial	*Cost trial*	*Classic trial*	*Color trial*
Wound infection	11.9%	2.5	8.7	3.3%
Persistent ileus	5.5%	2.8		
Evisceration	0.9%			0.8%
Bleeding	0.5%	1.2%	4.8%	1.9%
Anastomotic leak	0.9%		6.0%	2.3%
Pneumonia	0%		6.5%	1.9%
UTI	0.5%	1.2%		2.3%
ARF	1.4%			
DVT			1%	
Cardiac		2.6%		1.2%

(ARF: acute renal failure; DVT: deep venous thrombosis; URI: urinary tract infection)

Abdominopelvic CT scan with triple contrast (oral, intravenous, and rectal) has become the imaging modality of choice to evaluate suspected postoperative intra-abdominal infection. Specificity during the first 5 days postoperative, however, is reduced. During this period, infectious processes may be challenging to differentiate from acute postoperative inflammation and fluid collections. Sensitivity is much improved beyond 5–7 days. CT scan and contrast enema can also be used as complementary studies.

If there are large collections, it can often be amenable to percutaneous, transgluteal, or transanal image-guided catheter drainage. The images should be reviewed with an interventional radiologist to identify a safe window of access that avoids vascular structures and other organs. Abscesses <3–4 cm are too small for most pigtail catheters and will often resolve with a course of antibiotics. In the era of modern CT scanning and interventional radiology, the routine practice of repeat laparotomy, abdominal washouts, large sump drains, and open abdominal wound management is rarely necessary and can be reserved for patients who fail to respond to, deteriorate following, or are not candidates for percutaneous drainage.

Sometimes the management of the patient with progressive generalized peritonitis with or without septic shock requires resuscitation in ICU with broad spectrum antibiotics and urgent laparotomy. Laparoscopic management may be considered if the surgeon has sufficient laparoscopic skills and operative experience. At the time of surgery, the anastomosis should be scrutinized for signs, which led to its failure. This can guide the appropriate method of repair.

After laparoscopic colorectal surgery, if the findings at operation show ischemia and necrosis of greater than one third of the anastomosis, the anastomosis should be resected with the creation of a stoma. If the mucous fistula can be brought up to the skin, it should ideally be fashioned through the same site as the proximal ostomy. When performed in this fashion, subsequent ostomy reversal can be done via a circumstomal incision, obviating the need for formal laparotomy and its associated morbidity. If the findings at operation identify a smaller leak with healthy bowel, the anastomosis can usually be salvaged with suture repair, proximal diversion, and washout of the distal segment. Our preferred diversion is a loop ileostomy.

Early Postoperative Small Bowel Obstruction

After colorectal laparoscopic surgery, early postoperative bowel obstruction is rare, occurring in 1% of patients. This time period accounts for 5–29% of all small bowel obstructions. Most obstructions are caused by adhesions which form within 72 hours of surgery and then become very dense and vascular after 2–3 weeks. Obstructions are more common following colorectal and gynecological procedures than following appendectomy or procedures located above the transverse colon. Signs and symptoms of early postoperative small bowel obstruction are similar to and hard to differentiate from the more common paralytic ileus. Patients typically develop abdominal distention, nausea, and vomiting, but cannot tolerate nasogastric tube clamping or removal. Most patients have a slow, smoldering course, with emergencies being the exception.

The surgeon should try to manage obstruction conservatively initially. There is a fine balance between waiting for the obstruction to resolve and rushing a patient to the operating room. In the first week following surgery, obstruction is hard to differentiate from ileus. Between 2 weeks and 2 months, postoperative adhesions become thick, vascular, and obliterate natural planes, making surgery much more difficult and prone to complications. The decision to operate should, therefore, occur between 7 and 14 days.

If the patient has symptoms of obstruction, plain films readily diagnose most small bowel obstructions. Oral administration of water-soluble contrast followed by a plain abdominal film or CT scan 4 hours later is a good predictor of the resolution of a small bowel obstruction. The contrast in the colon indicates the obstruction is likely to resolve with nonoperative means. CT scan may be useful in identifying signs of ischemia, other intra-abdominal processes and in localizing the site of obstruction for operative planning.

Initial management of the stable patient involves fluid and electrolyte replacement, bowel rest, nasogastric tube drainage, and nutritional evaluation. Total parenteral nutrition should be started as soon as the detected leak. Operation is advised for high-grade or complete bowel obstruction, concern for strangulated bowel, or unresolved small bowel obstruction despite prolonged NGT decompression.

If proper care is ensured, most patients resolve with nonoperative management. If surgery becomes necessary, it should occur prior to the 2 weeks mark, after which the acute adhesions become dense, vascular, and problematic. Surgery involves careful re-exploration and lysis of adhesions. Operative findings usually reveal either a single adhesive band or multiple matted adhesions, each occurring with similar frequency.

After colorectal surgery, if obstruction develops, laparoscopic exploration and adhesiolysis is being increasingly utilized for small bowel obstructions. Advanced laparoscopic skills and experience are a prerequisite because access is difficult in these patients. Poor candidates for laparoscopic management include patients with signs of peritonitis, multiple previous operations for small bowel obstruction, small bowel diameter >4 cm, or other medical contraindication to laparoscopy. Pneumoperitoneum should be established with an open technique at a site remote from the previous incision. Atraumatic graspers are used to explore the bowel in a retrograde fashion beginning with decompressed bowel at the ileocecal valve. Distended bowel is fragile and should not be grasped: grasping the adjacent mesentery reduces the risk of inadvertent bowel perforation. Adhesiolysis is best performed with scissors or bipolar cautery devices to reduce the risk of adjacent bowel injury. Conversion rates range from 7 to 43%. Proactive reasons to convert include poor visualization, nonviable intestine, multiple dense adhesions, deep pelvic adhesions, and failure to progress in a reasonable time.

Sexual Dysfunction

Sexual dysfunction following rectal surgery is related to the extent of pelvic nerve dissection and occurs in both men and women. In men, damage to the sympathetic nerves during high ligation of the IMA or posterior dissection at the sacral promontory can lead to retrograde ejaculation. In addition, damage to the parasympathetic plexus (nerve erigentes) during lateral and anterior dissection can lead to erectile dysfunction. The pathophysiology of sexual dysfunction in women is likely multifactorial and includes damage to the parasympathetic nerves during deep pelvic dissection as well as postoperative mechanical changes in the pelvis, which contribute to loss of sexual desire, vaginal dryness, altered orgasm, and dyspareunia. Sexual dysfunction is more difficult to diagnose in women, in part because the presence of incontinence often discourages women from engaging in sexual activity.

TIPS AND TRICKS

To avoid intraoperative complications:

- Create adequate exposure.
- Use proper traction and counter traction.
- Develop the right planes.
- Standardize the assistant's role.
- Beware of the variations of vasculature and anatomy.
- Should visualization be compromised during the procedure?, it is easy to switch to a 30° laparoscope for a more topographical view. Applying the angled 30° laparoscope can also be helpful to manage external arm collisions during tight set-up situations, as the camera arm angle changes depending on the endoscopy used. Additionally, with an angled 30° laparoscope, the surgeon has the ability to rotate the viewing angle of the scope (out of the horizontal image plane) and minimize collisions as well.
- Leave 1–1.5 cm on either side of the transacted IMA and IMV so that if any bleeding occurs, grasping of the vessel is still possible to allow the application of the hemostatic technique (clips, LigaSure™ or suture).
- Distance the ports as much as possible from each other during initial port placement (minimum of 7.5 cm). Placing the patient in a steeper Trendelenburg position can increase the vertical spacing between the arms and potentially eliminate or minimize arising collisions.
- Before dividing any tissues, identify the ureter and gonadal vessels one more time.
- During all procedure steps, clear communication with the patient-side assistant is essential.

CONCLUSION

The laparoscopic technique reduces parietal aggression and achieves the same results as traditional surgery. Patients recover faster and experience less pain, with fewer wound infections, postoperative hernias, less time in the hospital, and reduced costs. But laparoscopic colonic surgery requires extensive and highly specialized training, with few surgeons qualified to perform these procedures. The recent conclusion of the oncologic debate, together with the rapid development of technological means and the increase in public awareness, will probably result in a substantial increase in the number of surgeons performing laparoscopic colorectal surgery. The laparoscopic technique is an excellent approach, though not yet the gold standard. Smooth performance of this technique depends on the quality of the equipment, perfect knowledge of the operative steps, exposure of operative field, and the experience of the surgical team. Operative times are somewhat longer than open procedures but become shorter along the learning curve. Right colectomies are shorter and easier to perform than left-sided and rectal resections and should be employed for teaching residents. The conversion rate would not necessarily drop after the first 50 cases and should reflect good surgical judgment rather than a surgical failure.

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