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Recent Advances in Minimal Access Surgery

Editor-in-Chief

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CHAPTER 20

The "Triple-track Technique for Laparoscopic Proctocolectomy" in Colonic Neoplasia: Optimizing Minimal Access Surgical Oncology

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INTRODUCTION

Neoplastic conditions of the colorectum including cancers are highly treatable and often curable (about 50–70% of patients) when localized to bowel. Radical resection of the segment of bowel bearing the tumor [complete mesocolic excision (CME) for the colon and total mesorectal excision (TME) for the rectum] with a systematic lymphadenectomy having tumor-free margins (in three dimensions), characterizes surgery with an intention to cure for malignant neoplasms of the colorectum. Performed still largely through the open access surgical approach globally, numerous multicontinental phase-3 trials in the mid-1990s and subsequent advocacy validated the short-term and long-term oncological efficacy of laparoscopic colorectal cancer surgery.[1-5] However, these multinational trials largely studied segmental colonic resections. Segmental resections can test a surgeon by the need to contend with numerous critical anatomical and vascular landmarks within a domain that can be ergonomically challenged by mobile omentum, small bowel loops, mobilized large bowel and previous operations, the bulky, unwieldy nature of the colon, and retroperitoneal location of key vascular structures. Long segment colorectal oncological resections such as subtotal colectomy and total proctocolectomy challenge the surgeon further and mandate a planned approach to surgery. Thus, multisegmental colorectal resections even now remain the domain of individual case series and reports. We present our early experience of laparoscopic restorative total proctocolectomy, in colonic neoplasia.

RATIONALE FOR THE TRIPLE-TRACK TECHNIQUE FOR LAPAROSCOPIC PROCTOCOLECTOMY

Minimal access proctocolectomy has been described through conventional multiport,[6-9] reduced-port,[10] single-incision,[11,12] hand-assisted, or hybrid[13] laparoscopic approaches since 1990s. Of late, robotic techniques have been employed too.[14-16] The endoscopic approach leverages the magnified vision of laparoscopy, especially for key operative steps such as the high-vascular capture of concerned lymphovascular basins in addition to the manifold minimal access surgical advantages (less wounding, smaller scar, early

return of organ function, early return to activity, better cosmesis, lower rate of perioperative complications, decreased formation of adhesions, and thus reduced occurrence of intestinal obstruction) of laparoscopic surgery. The primary indications for (single/double/triple stage) restorative proctocolectomy have been inflammatory bowel disease (mainly ulcerative colitis) and polyposis syndromes [notably familial adenomatous polyposis (FAP)]. Irrespective of the approach used to perform a proctocolectomy, the procedure remains a near tour-de-force operatively. The procedure spans all four abdominal quadrants and pelvic domains, encounters virtually every major gastrointestinal organ, encompasses all major abdominal vascular territories, approximates nearly every retroperitoneal structure, involves disconnecting proximal enteric vasculature and fascial attachments, and entails creating a major gastrointestinal anastomosis in a tension-free, well-vascularized manner. The primary endoscopic challenge of this large colorectal mobilization is the preservation of optimal endovision through the long procedure, ergonomic surgical control of the mobile and bulky colorectal specimen, and precise high-vascular control of multiple lymphovascular points to achieve proper cancer surgical resection objectives.[17-19] Authors have described various combinations of colorectal mobilization, with techniques describing dissection sequentially antegrade from the ileocecum distally, retrograde from the rectum proximally, or nonsequentially with initial left and sigmoid colectomy with proctectomy prograde, followed by right and transverse colectomy.

We present our preference and variation to the above techniques, the "triple-track" technique for laparoscopic proctocolectomy, a technically ergonomic and oncologically valid technique. Our technique is unique as it helps to maintain domain and ergonomy for laparoscopic surgery as the colorectal resection is completed in a planned and in an almost choreographed manner. This nonlinear, staggered sequence of completing the most challenging segment of the operation first by dissecting the inferior mesenteric artery (IMA) territory first (sigmoid, descending, and distal transverse colon; considered to be the most technically difficult for laparoscopic colectomy), followed by the superior mesenteric artery (SMA) territory of the colon (cecum, ascending, and proximal transverse colon; considered to the be the easier segments for laparoscopic colectomy), and lastly the rectum (likely to be technically straightforward) prevents a prior mobilized bulky cecum and ascending colon along with the already mobile small bowel from potentially compromising endovision and ergonomy, especially in high-ligating the IMA and distal-ligating the inferior mesenteric vein (IMV), both essentials in an oncological resection.

TECHNICAL SUMMARY

In short, three sets of dissection are completed, using a modified-lithotomy position with four 12-mm and two 5-mm ports. First, the initial, "left-track" dissection is begun antegrade, mobilizing sigmoid-distal transverse colon

with "high-transection" of the inferior mesenteric vasculature. Second, the "right-track" dissection is begun prograde with the retrocolic mobilization of the ascending colon and hepatic flexure, attended with "high-transection" of the ileocolic, right, and middle colic vasculatures. Third, a total-mesorectal dissection in the "pelvic-track" mobilizes the rectum, which is transected at the anorectum. The specimen is extracted through a midline subumbilical or a Pfannenstiel incision. This sequence provides excellent ergonomics which enables a complete en-bloc resection. An ileal "J"-pouch is created extracorporeally, and a laparoscopy-assisted ileal pouch anal anastomosis performed using a 29-mm circular-stapler. A diverting loop ileostomy completes the procedure, which is closed 3 months later.

AIM

To perform an ergonomic laparoscopic-assisted total proctocolectomy that is oncologically valid.

OBJECTIVES

To technically reach the definitions of radical colorectal (R0) en-bloc resections (CME for the colon and the TME for the rectum) fulfilling the following:[20-26]

- Longitudinal tumor-free margins of 10 cm or more (proximally and distally)
- Radial tumor-free margins (invasive carcinoma present > 1 mm from the margin)
- A systematic D3 lymph node dissection, confirmed by the high vascular capture/ligation (HVL) of the root (origin) of the named vascular pedicle, to yield the maximum mesocolic lymph node yield (> 12/segment). A D3 lymph node dissection would include the three principal colonic lymph node groups: paracolic lymph nodes, intermediate lymph nodes, and nodes at the root of the mesenteric root (central lymph nodes)[27,28]
- Avoid direct manipulation or rupture of the tumor (Turnbull "no-touch" technique)
- Safe extraction of the intact specimen from the abdomen without tumor or bowel content spillage.

INDICATIONS

Laparoscopic proctocolectomy is indicated when pan colorectal malignant risk is perceived or confirmed and is amenable to laparoscopic resection. The following represent such conditions:[6,7]

- Familial adenomatous polyposis
- Hereditary nonpolyposis cancer (HNPCC)
- Synchronous cancers

Where the malignant tumor/s (if present) is localized to the colon (T3), with the largest tumor dimension less than 8 cm, preservation of an ergonomic domain intracorporeally, elective setting and absence of medical contraindications to laparoscopic surgery (Figs. 1A and B).

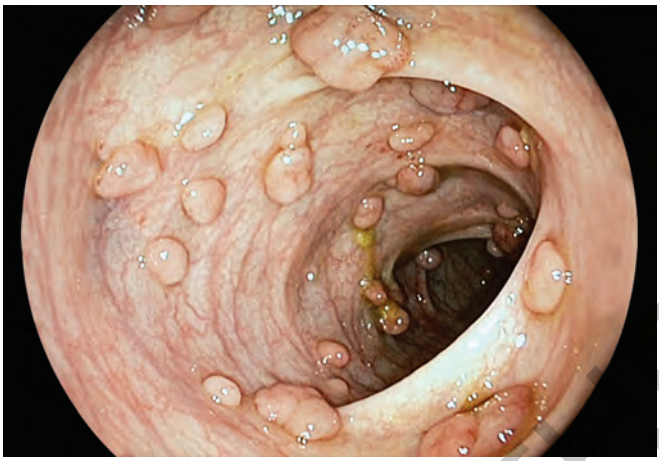

Fig. 1A: Colonoscopic view of familial adenomatous polyposis (FAP) polyps.

Fig. 1B: Colonoscopic view of familial adenomatous polyposis (FAP) polyps (close up).

CONTRAINDICATIONS

The following represent contraindications to a laparoscopic proctocolectomy:

- Tumor invading surrounding structures (T4)
- Tumor dimension/s more than 8 cm
- Medical contraindications to laparoscopy
- Surgical contraindications to laparoscopy, e.g. dense abdominal adhesions or severely dilated bowel due to tumor obstruction
- Emergency surgery.

PATIENT PREPARATION

Accelerated postoperative recovery or Enhanced Recovery after Surgery (ERAS) protocols have changed perioperative care and outcomes.

The following summarizes our practice in relation to preoperatively preparing the patient for surgery:

- Proactive and pre-emptive counseling of the patient and family about early ambulation and feeding
- The patient's bowel is prepared for surgery with polyethylene glycol (e.g. a Peglec sachet reconstituted in 1–2 L of water drunk over about 2–3 hours) the evening before the day of surgery. This helps in palpating the tumor during laparoscopic surgery to confirm its location and improve the intra-abdominal domain for enhanced visualization and consequent ergonomics.[25,29-31]
- We do not yet routinely employ pre-operative endoscopic tattooing of the tumor (with India ink) to enable its localization during laparoscopy. This may be necessary in the future as patients get increasingly obese and intraoperative localization becomes challenging.
- Multimodality venous thromboembolism (VTE) prophylaxis is administered appropriate to VTE risk, usually comprising low-molecular-weight heparin (LMWH) (e.g. enoxaparin 40–60 mg subcutaneously) administered 8–12 hours prior to the surgery. In addition, thigh-length antiembolic stockings (T.E.D.™) are applied to the lower limbs of the patient preoperatively, and thigh-length intermittent pneumatic compression garments (e.g. SCD™ Express) are applied preinduction of anesthesia.
- Surgical antibiotic prophylaxis (e.g. cefoperazone 1 g and metronidazole 500 mg intravenously) is administered prior to induction of anesthesia. Recent times mark a return to oral antibiotic regimen (Nichols-Condon bowel preparation) consisting of neomycin and erythromycin given the day before surgery.
- A nasogastric (Ryles) tube is placed to decompress the stomach and useful while dissecting the gastrocolic ligament. It is usually removed postoperatively once the ileostomy moves.
- The patient's urinary bladder is catheterized (Foley) to protect it from accidental injury for instance by the suprapubic port. It is usually removed postoperatively (4–5 days).
- We do not catheterize the ureters routinely; we do so only if the primary tumor is found to be large (about 7–8 cm on preoperative imaging) and is suspected to be adherent to surrounding structures such as the right ureter.
- Marking of the ileostomy site preoperatively is mandatory. The ileostomy site should be placed through the rectus abdominis muscle. The site should be marked ideally with the patient lying flat, sitting, and standing to identify the best site in relation to skin folds and beltlines while also ensuring that the obese patient can see the ostomy site.

OPERATIVE THEATER SETUP

A spacious operative theater, adequately equipped is important to allow for ergonomic logistics; the operative table (an electric-powered operative table with a hand-held remote control, e.g. by Maquet/Schmitz); high-definition laparoscopic endovision equipment (either boom-mounted/trolley-

supported); a zero-degree (0°) and an angled (30°) laparoscope; a secondary screen for the assistants; energy devices such as monopolar electrocautery, ultrasonic shears (e.g. HARMONIC Ace®, Ethicon; Somerville, NJ, USA) and bipolar-thermal fusion device (LigaSure™, Covidien; Boulder, CO, USA); surgical suction; wound protector; standard laparoscopic instruments; and instrument tables. With increasing obesity and the higher probability of entering a previously operated abdomen in current times, the role of special laparoscopic instruments such as atraumatic graspers (e.g. Hunter grasper); bowel-retracting forceps; and longer (45 cm), sturdier bowel forceps become important.

The operating room equipment is aligned in the following fashion:

- *Main high-definition screen:* Placed toward the lower left side of the patient during the early "left-track" stage of the operation, to the upper left side of the patient during the late "left-track" stage of the operation (splenic flexure dissection), and center of the head-end of the patient, above the operative drapes during the "right-track" stage of the operation and the center foot-end of the patient during the "pelvic-track" stage of the procedure
- *Secondary screen:* Placed to the right of the patient so that it is visible to the assistant holding the laparoscopic camera
- *Laparoscopic cart, energy devices, suction, and irrigation:* Placed at the right side of the patient to allow for ergonomic "connections" to be made with the laparoscopic camera, insufflation tubing, suction tubing, irrigation tubing, and energy device connections
- *Operative instrument main trolley:* Placed at the foot end of the patient near the operating scrub nurse (toward the right side of the patient), so the instruments are easily accessible
- *Secondary instrument trolley:* Placed toward the left-side foot end of the patient.

ANESTHESIA

General anesthesia: The options for postoperative analgesia include continuous epidural infusions, patient-controlled analgesia (PCA), and local anesthetic at port, incision, and drain sites with conventional parenteral/enteral analgesia.

PATIENT POSITION

- The patient is positioned in the modified (minimal hip-flexion) lithotomy position with both arms tucked, secured, and covered (insulated) at the sides, after induction of general anesthesia, to enhance ergonomics at the operating table.
- The patient is secured to the operating table to avoid slippage during extreme positioning. It is highly desirable to have an electric-powered operative table with a hand-held remote control to easily and rapidly orient the table to the desired position.

- The patient's abdomen is cleaned (5% povidone iodine) and draped in a sterile manner.
- The table is oriented through the following steps at various stages of the procedure:
  - *Diagnostic laparoscopy:* Reverse Trendelenburg/Trendelenburg position and side-tilt according to the quadrant being examined
  - *"Left-track" stage:* Trendelenburg position with left side-up tilt initially and reverse Trendelenburg with left side-up tilt later
  - *"Right-track" stage:* Trendelenburg position with right side-up tilt initially and reverse Trendelenburg with right side-up tilt later
  - *"Pelvic-track" stage:* Trendelenburg position and steep Trendelenburg position if needed
  - *Specimen extraction:* Neutral
  - *Check laparoscopy:* Reverse Trendelenburg/Trendelenburg position and side-tilt according to the quadrant being examined.

POSITION OF THE SURGICAL TEAM

- The operative theater space is optimized by the ergonomic alignment of operative personnel and equipment. The surgical team is aligned in the following fashion (Fig. 1C):
- *Operating surgeon:* Stands to the right of the patient during the "left-track" stage of the operation and between the legs of the patient through the late "left-track" stage of the operation (splenic flexure dissection), the "right-track" stage of the operation and back to the right of the patient during the "pelvic-track" stage of the procedure
- *Assistant surgeon holding the laparoscopic camera:* Stands to the right of the patient (cephalad to the operating surgeon) during the "left-track" stage

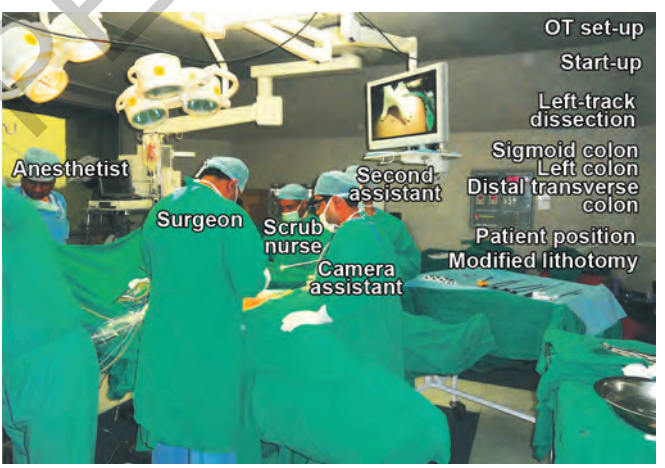

Fig. 1C: Patient position and operative room (or) set-up for the left-track dissection. (OT: operation theater)

of the operation, to the left of the patient during the "right-track" stage of the operation and back to the right of the patient during the "pelvic-track" stage of the operation

- *Second assistant surgeon (retracting surgeon):* Stands to the left of the patient during the operation
- *Operating scrub nurse:* Stands to the right of the patient.

PORT STRATEGY

Carboperitoneum is created by closed technique with Veress needle. The laparoscopic ports and trocars are placed under vision as illustrated in Figure 2.

- The primary/initial camera port is placed at the umbilicus (10–12 mm trocar) under optical guidance.
- Secondary ports are inserted in a near "circumferential" manner at the following locations, to facilitate "triangulation" of instruments.
  - *Suprapubic port:* Secondary camera port/working port, 10–12 mm trocar
  - *Right iliac port:* Right/left-hand working port, 10–12 mm trocar
  - *Left subcostal port:* Left paramedian location along the left midclavicular line for sigmoid and ascending colon retraction and acts also as an alternate right-hand working port, 10–12 mm trocar
- *Right subcostal/subxiphisternal port:* Left/right hand working port, 5 mm trocar
- *Left iliac port:* Right/left hand working port, 5 mm trocar.

We discourage the intraoperative replacement/exchange of trocars, to prevent potential port site metastasis from the seeding of port sites by aerosolized tumor.

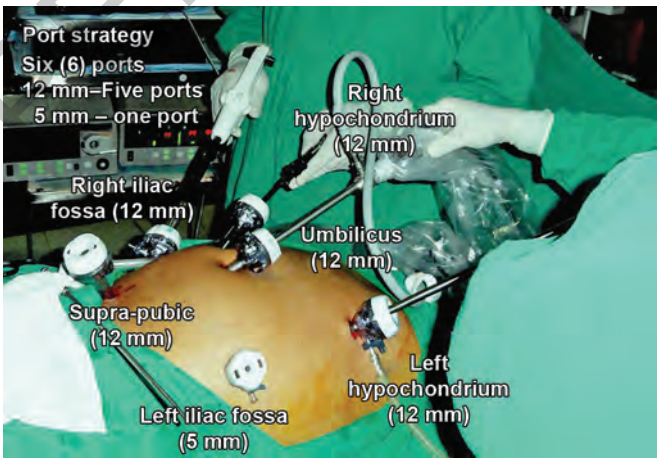

Fig. 2: Port strategy.

STAGES OF THE OPERATION

The following description of the operation divides into the followings various phages:

- Diagnostic (exploratory) laparoscopy
- "Left-track" stage
- "Right-track" stage
- "Pelvic-track" stage
- Minilaparotomy and specimen extraction
- Bowel resection and ileal pouch creation
- Abdominal closure, intracorporeal anastomosis, and ileostomy
- Check laparoscopy
- Examination of the specimen

Diagnostic (Exploratory) Laparoscopy

This step confirms the intraperitoneal site and stage of the tumor and initial feasibility of the laparoscopic approach. Confirm the location and surgical stage of the primary tumor by mass effect, serosal puckering, preoperative colonoscopic tattooing with India ink, and possible extension to adjacent structures by checking lesion mobility/fixation. Examine the mesocolon and mesentery for enlarged lymph nodes, to ensure their inclusion in the resection. Confirm the intraperitoneal stage of the disease by examining the peritoneal surfaces of the bowel, mesentery, omentum, liver, and pelvis (see Figs. 1C and 2).

The Left-Track Stage

First, the initial, "left-track" dissection is begun antegrade, mobilizing sigmoid-distal transverse colon with "high-transection" of the inferior mesenteric vasculature. We adopt a modified medial to lateral approach for this stage of the operation, by mobilizing the sigmoid colon from its congenital adhesions to the lateral abdominal wall and open the Toldt line here and cephalad along the descending colon to drop these colonic segments by blunt and sharp dissection till the ureters are identified lying laterally. To ensure a CME, it is urged to open the correct fascial plane by retracting away the sigmoid-descending colon segment medially and opening the loose fissile areolar tissue between the visceral fascia over the mesocolon and the parietal fascia of the lateral abdominal wall laterally and the Gerota's fascia dorsally. This will also ensure that the lymphovascular basin contained in the mesocolon remains intact and protect the gonadal vessels and ureter from inadvertent injury as they lie within the endoabdominal fascia dorsolaterally. This now sets the stage for the ideal dissection, capture, and transection of the inferior mesenteric vasculature. First the IMA is targeted by retracting the sigmoid colon and mesocolon ventrally by a bowel grasper through the left subcostal port and opening the peritoneum covering the medial aspect of the sigmoid mesocolon about 1 cm above the pulsations of the aorta to avoid inadvertent injury to the superior hypogastric plexus. The traction on the sigmoid mesocolon draws the IMA taut and easier to identify it in the mesocolon.

This can become somewhat challenging in an obese patient with a fatty mesocolon, but careful and measured dissection here will ensure anatomical identification, operative safety, and steady surgical progress. This initial dissection will render a mesocolic window-of-safety at the base of the sigmoid mesocolon allowing viewing of the laterally lying gonadal vessels and ureter at a safe distance. The IMA is then identified, confirmed, dissected, double-clipped securely (Hem-o-lok; Polymer Locking Ligation System, Weck®), and transected near-flush with the aorta to protect the superior hypogastric plexus. The dissection is then taken cephalad to open the peritoneum from the base of the sigmoid mesocolon cephalad along the medial extent of the left mesocolon till the base of the transverse colon. The IMV is identified along this margin and dissected, double-clipped securely (Hem-o-lok; Polymer Locking Ligation System, Weck®), and transected at the lower border of the pancreas. The mesocolic visceral fascia of the left and sigmoid colon is then in a medial to lateral fashion lifted off the Gerota fascia (dorsally) beginning at the level of the IMV. This creates a large mesocolic window to help set up the next surgical phase of mobilizing the splenic flexure, gastrocolic ligament, and distal transverse mesocolon. Traction is applied to the distal transverse colon to stretch the gastrocolic ligament till the splenic flexure. An opening is made in the gastrocolic ligament below the greater curvature of the gastric body to open the lesser sac with the Harmonic scalpel and the mobilization is carried laterally till the splenic flexure is mobilized completely. Safety during mobilization at the splenic flexure is enhanced by identifying the pancreas and keeping above it. The last step in this stage is the detachment of the distal transverse mesocolon from the pancreas medially to the splenic flexure laterally (Figs. 3 to 8).

The "Right-Track" Stage

Second, the "right-track" dissection is begun prograde with the retrocolic mobilization of the ascending colon and hepatic flexure, attended with

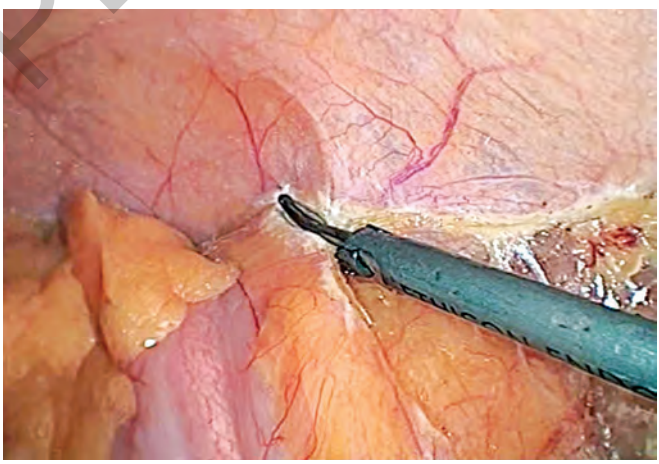

Fig. 3: Lateral release of sigmoid mesocolon.

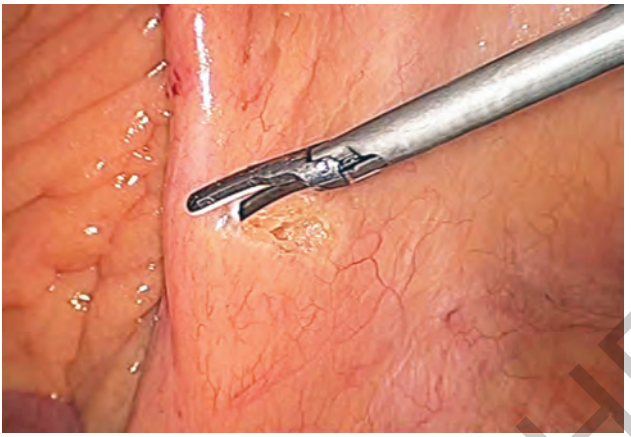

Fig. 4: Targeting the inferior mesenteric artery (IMA).

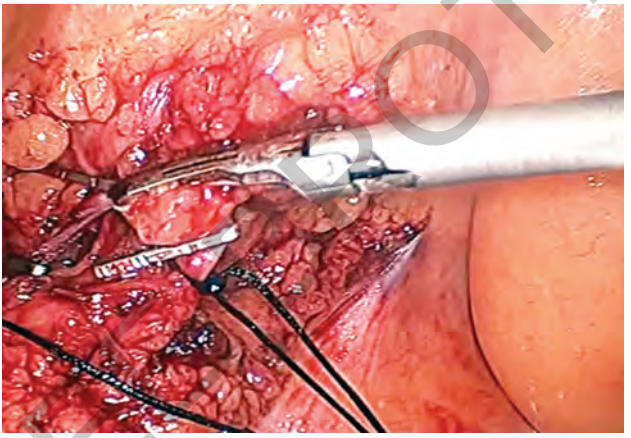

Fig. 5: High-transection of the inferior mesenteric artery (IMA).

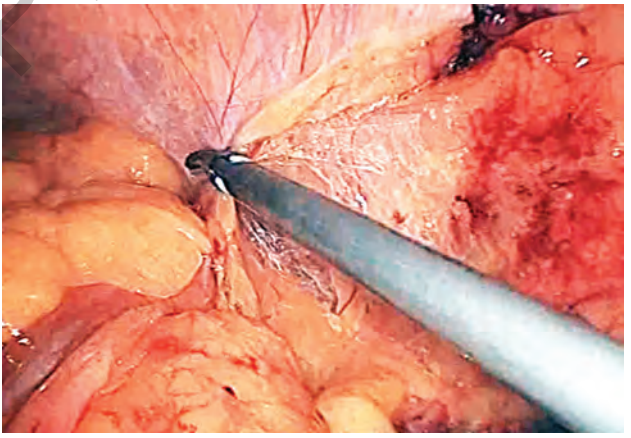

Fig. 6: Medial peritoneal opening—targeting the inferior mesenteric vein (IMV).

IAGES Recent Advances in Minimal Access Surgery

Recent Advances in Minimal Access Surgery is compilation of various current topics related to minimal access surgery (MAS) and gastrointestinal endoscopy contributed by various authors across the world. This is first of the series of books on this topic in world literature. The book is likely to meet the ever increasing demand of such a periodical to highlight the rapid changes in techniques and emergence of new technologies and thus to keep the readers updated on these changes.

This edition covers various topics on basics and advanced MAS procedures and the future editions are likely to be more organ and subject specific.

Subhash Khanna MS FICS FIAGES FALS is Head, Department of Minimal Access Bariatric and GI Surgery, Swagat Super Speciality Surgical Institute & NH and Dean, Swagat Academy of Medical Sciences, Guwahati, Assam, India. He is an exceptionally skilled and internationally acclaimed Laparoscopic Surgeon with a passion for GI endoscopy. He had a brilliant academic career and had been a most sought after teacher at Gauhati Medical College. He has contributed richly and immensely to development of Minimal Access Surgery in Assam, from its onset to zenith. He has introduced several novel procedures for the first time in the north east India. Recipient of various awards, orations and CME lectures. He has authored chapters for various books, an editorial board member of "Journal of Minimal Access Surgery" and also associate editor of the recently published book "Comprehensive Laparoscopic Surgery". Considering his many distinguished accolades, his dedication and scholastic excellence coupled with professional excellence, he has been selected for the prestigious "Dr BC Roy National Award" in the category of "Eminent Medical Teacher" for the year 2017. He serves as the National President of Indian Association of Gastrointestinal Endo-Surgeons, a strong body having over 7000 members and is also elected unopposed Vice President of International College of Surgeons (Indian Section).

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