Laparoscopic Colorectal Surgery

R.K.Mishra

Incidence

The sigmoid colon is the most frequent location for colon cancer. Sigmoid colon resection is the first line treatment in most cases of sigmoid colon cancer. A laparoscopic approach may be used to perform sigmoid resection in a manner equivalent to the open technique. Indeed, most laparoscopic surgeons consider laparoscopic sigmoidectomy relatively straightforward.

Laparoscopic sigmoid colon resection for cancer was described in a standardized manner as early as 1994 (Geis et al., 1994). Nevertheless, it should be reserved for highly skilled surgical teams participating in controlled multicenter studies.

Introduction
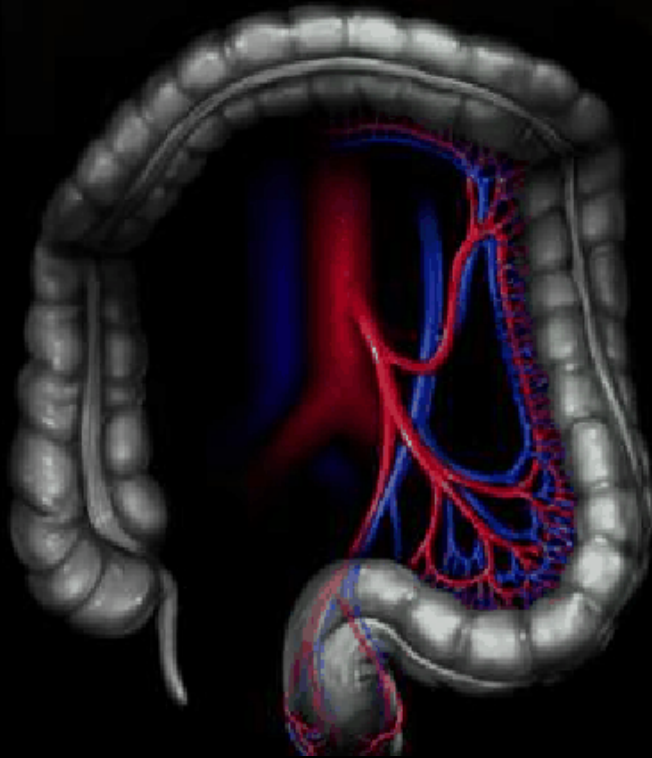
The sigmoid colon is the mobile terminal portion of the left colon. Except in advanced stages of cancer, the mobility of the sigmoid colon depends on the length of the sigmoid loop and on cancer-associated pathologies such as diverticulosis.

The vascular supply of the sigmoid colon is based entirely on the inferior mesenteric artery and its branches. Thorough knowledge of the vascular anatomy and its variations is essential for a safe resection.

The close proximity of the vessels to the left sympathetic trunk and the left ureter represents potential risks in sigmoid colon resection.
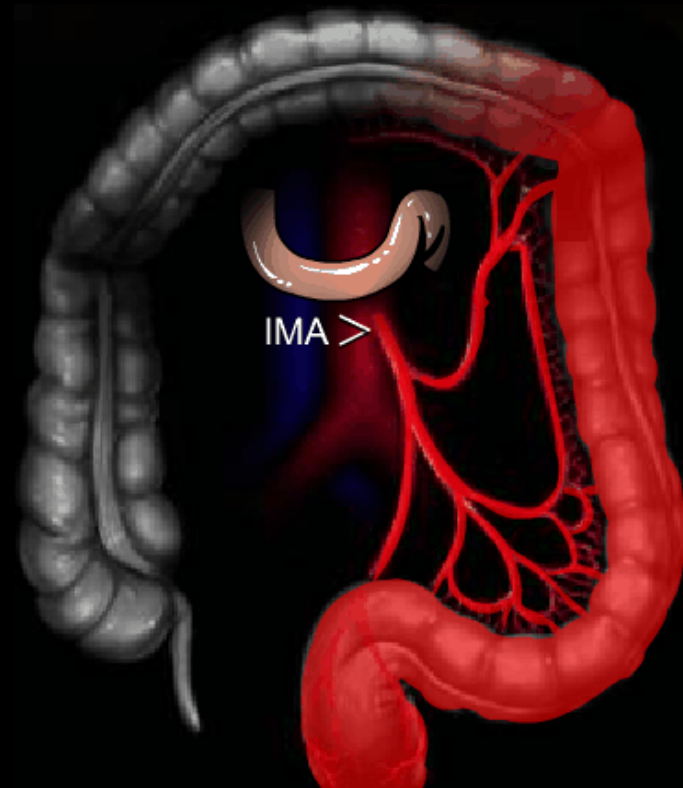
Anatomy
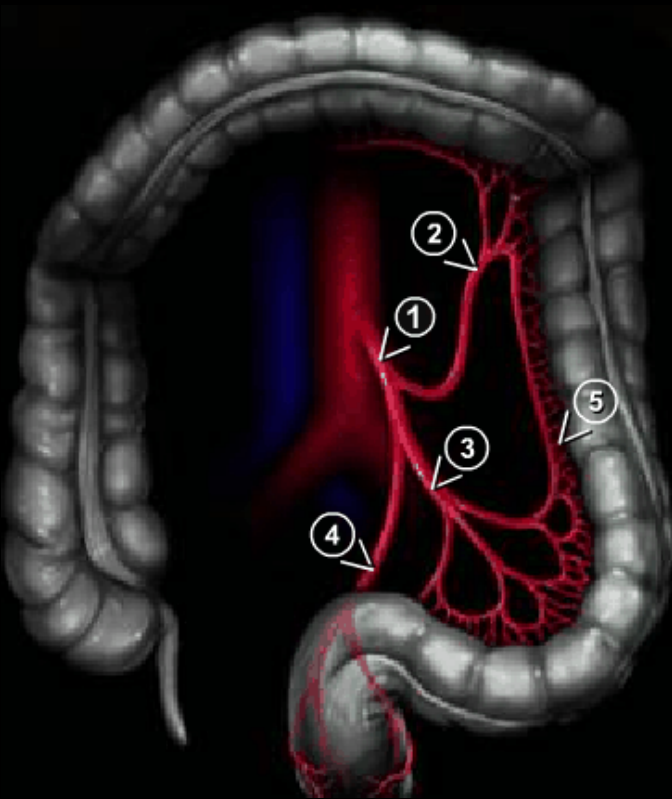
The arteries are all branches of the inferior mesenteric artery (IMA).
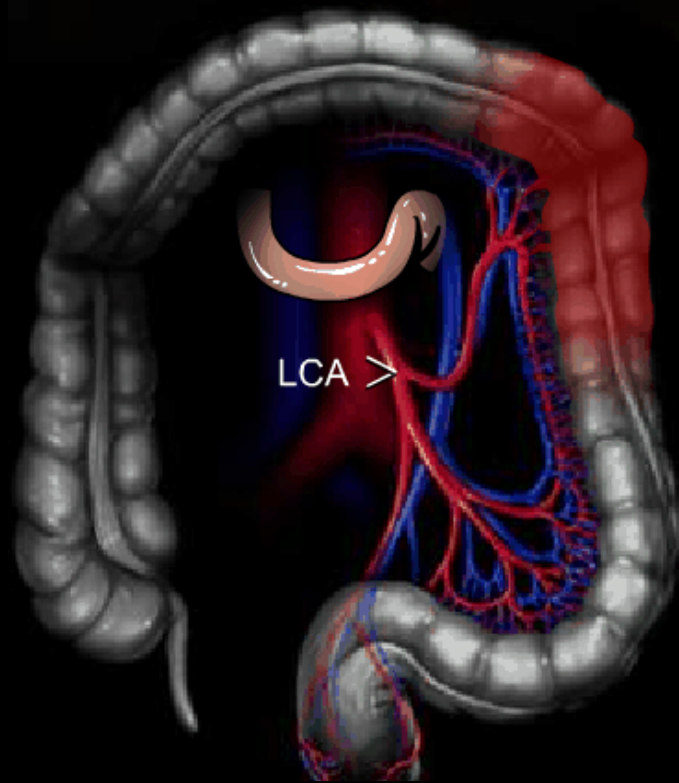1. Inferior mesenteric artery (IMA)
2. Left colic artery (LCA)
3. Trunk of sigmoid arteries
4. Superior rectal artery (SRA)
5. Marginal arteries

Anatomy

IMA >

The inferior mesenteric artery (IMA) originates from the anterior surface of the abdominal aorta, 1 to 3 cm below the third portion of the duodenum, to form the main blood supply of the left colon. It gives off branches for the left colon, the sigmoid colon, and the rectum.

Anatomy

The left colic artery (LCA) is the first branch of the IMA and supplies the vasculature of the left colon. After crossing over the inferior mesenteric vein (IMV), the LCA courses along the IMV's left border for a variable distance. It then approaches the marginal arteries, which it generally joins somewhere between the splenic flexure and the transverse colon. Its preservation is possible during mobilization of the left colon.
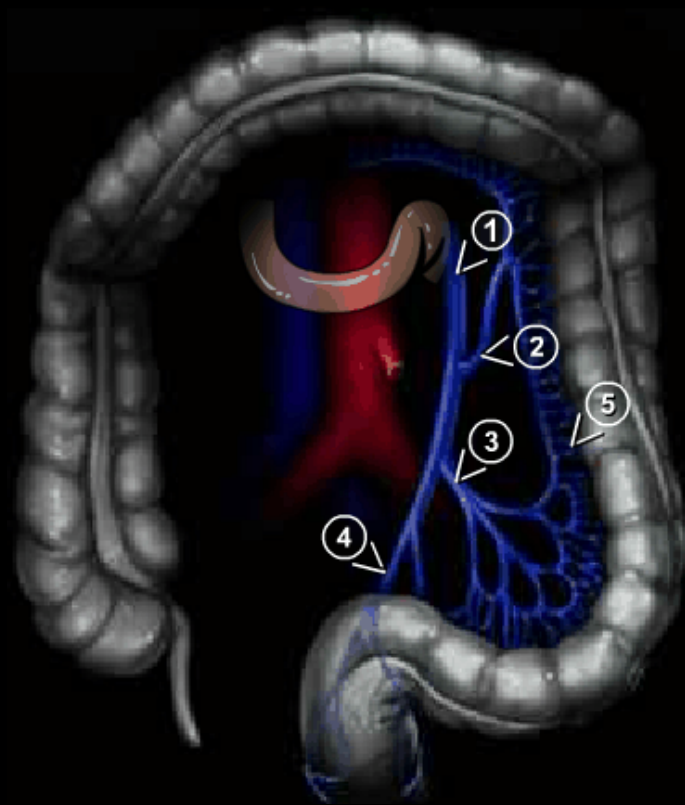
Anatomy

There are at least 3 sigmoid arteries (SA), often originating from a common trunk distal to the LCA. Variations are common. These sigmoid branches can originate separately from the IMA up to the promontory or from the LCA. They are always situated medial to the sigmoid veins and posterior to the superior rectal vein.

Anatomy
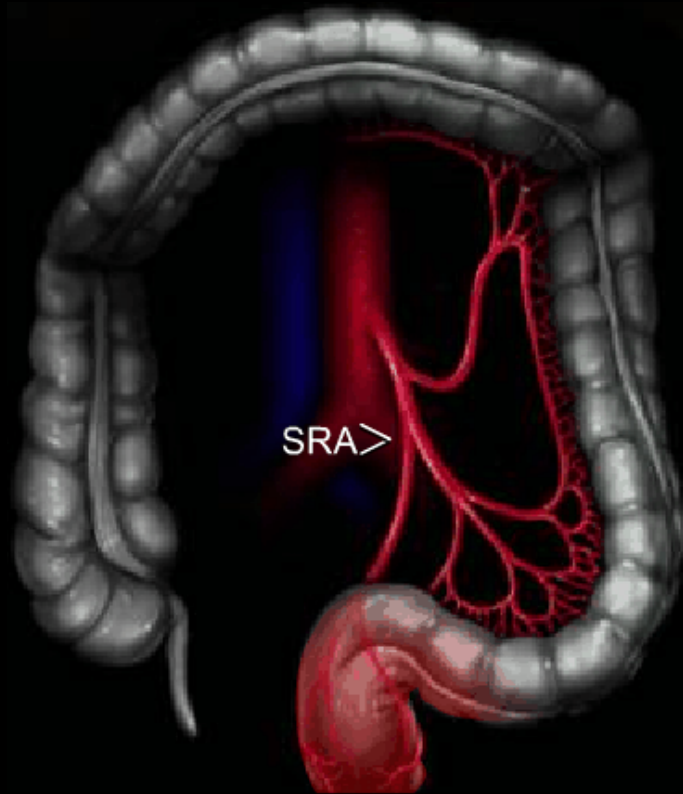
The superior rectal artery (SRA) is the terminal branch of the IMA. It is located just anterior to the fascia propria of the rectum at the rectosigmoid junction. It gets progressively closer to the rectal wall as it divides into a right and a left branch, or into even more branches in 17% of cases (Ayoub, 1978). These branches supply the upper two thirds of the rectum. The larger right branch often extends from the IMA (Ayoub, 1978). These 2 branches divide 2 or 3 more times without anastomosing and end on the pelvic floor. All these arterial branches remain in the mesorectum along with the rectal veins, which drain into the superior rectal vein (SRV) and then into the IMV.
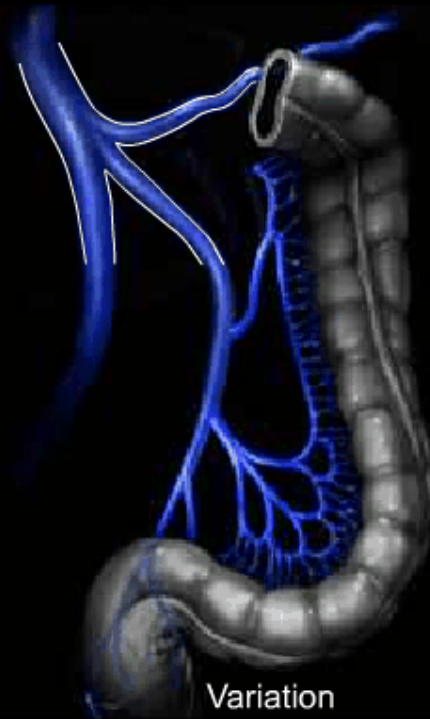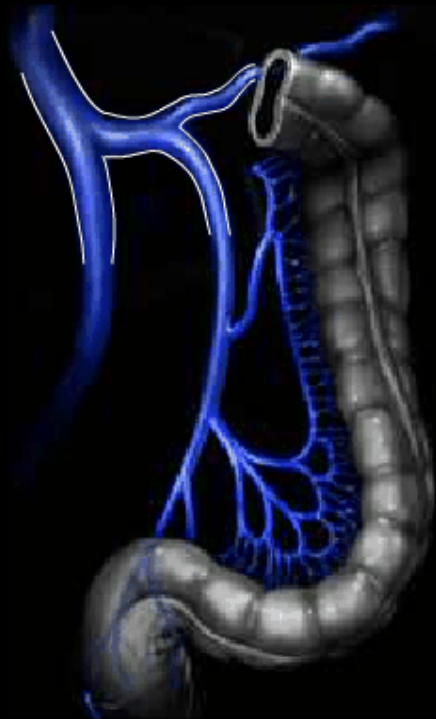
Anatomy

Rectal, sigmoid, and left colic veins join to form the inferior mesenteric vein (IMV).
1. Inferior mesenteric vein (IMV)
2. Left colic vein (LCV)
3. Trunk of sigmoid veins
4. Superior rectal vein (SRV)
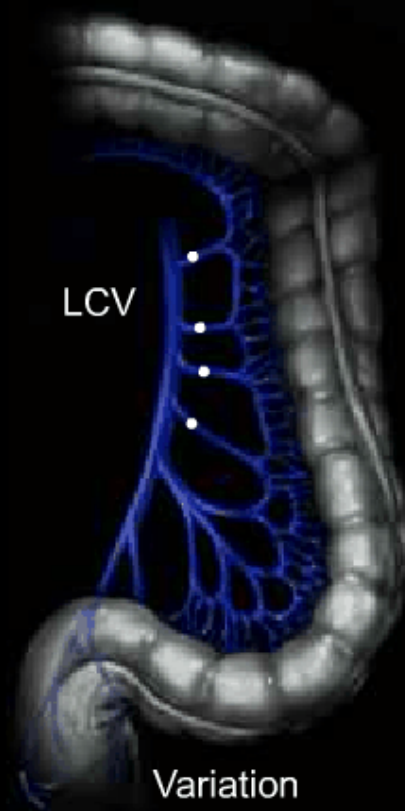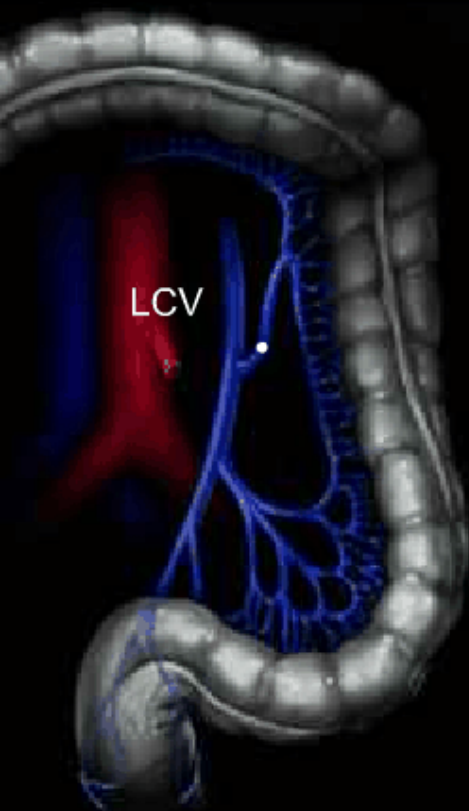5. Marginal veins

Anatomy

Variation

The sigmoid and left colic veins join to form the inferior mesenteric vein (IMV).
1. Portal vein
2. Splenomesenteric trunk
3. Splenic vein
4. Inferior mesenteric vein (IMV)
5. Superior mesenteric vein (SMV)

Anatomy

LCV

LCV

Variation

The left colic veins (LCV) often join into a main trunk. There are often 2 LCVs for 1 LCA. Accessory venous branches, originating from the descending colon, run directly into the IMV. They must be divided to allow mobilization of the left colon.
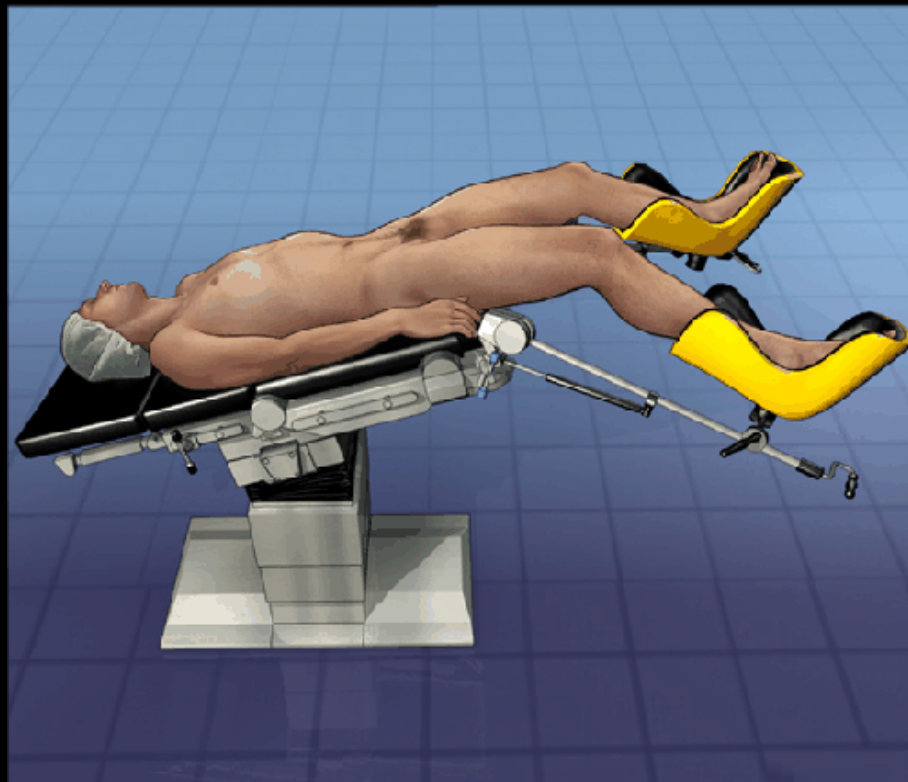
Bowel Preparation

An empty digestive tract facilitates the layering of intestinal loops. It is achieved by a strict, fiber-free diet 8 days prior to surgery.
Polyethylene glycol is prescribed 2 days before surgery to complete the intestinal preparation.

- 8   - 2   0

Patient Position

It is essential that the patient be appropriately positioned to avoid complications (nerve and vein compression, injuries to the brachial plexus) and to facilitate the procedure and anesthetic monitoring.
- Trendelenburg position with a 15° to 25° tilt and a 5° to 10° right tilt;
- lithotomy position;
- buttocks placed at the distal edge of the table;
- thighs and legs stretched apart with a slight flexure;
- right arm alongside the body;
- left arm at a right angle or alongside the body (surgeon's preference);
- gastric tube and urinary catheter;
- heating device.

Position of Surgical Team
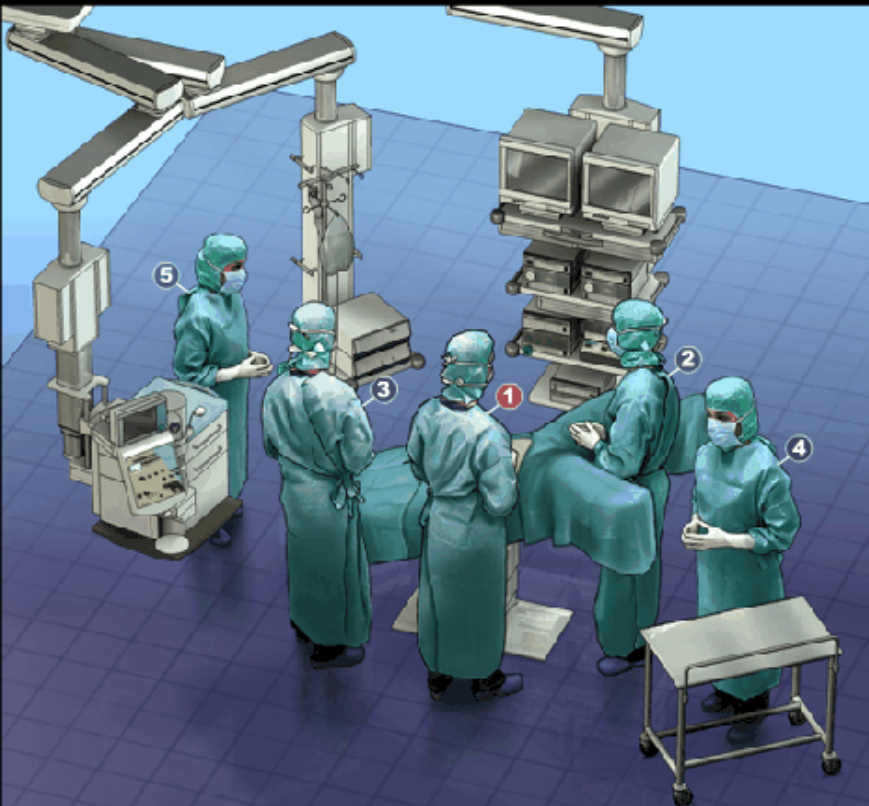
1. Surgeon
2. First assistant
3. Second assistant
4. Scrub nurse
5. Anesthesiologist

Although the procedure can be performed with a single assistant, it is preferable to have 2 assistants and a scrub nurse, especially when experience in performing the procedure is limited.

The team can remain in the same position throughout the entire procedure.
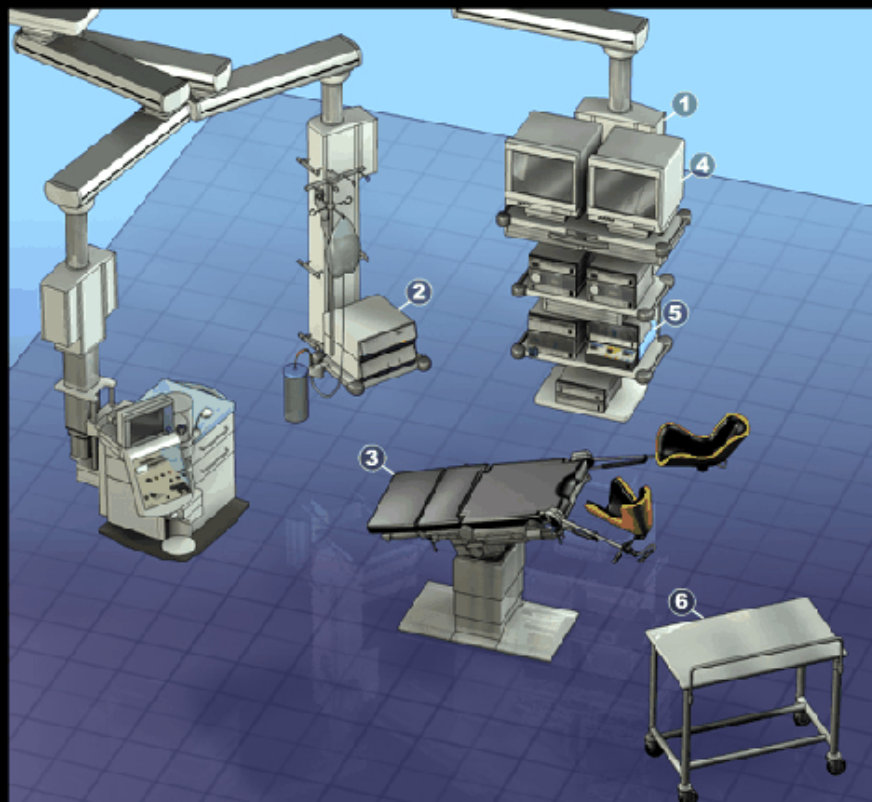
- The table must allow for both abdominal and perineal access. It is advisable to use a table that can be easily tilted laterally and placed into steep Trendelenburg and reverse Trendelenburg position, facilitating perineal exposure.
- The laparoscopic unit is located to the left of the patient along with the main monitor. It may be useful to use a second monitor placed above the patient's head.
- To perform the procedure in excellent conditions, a 3CCD camera is mandatory.
- A high output (>= 9L/min) insufflator should be used to electronically monitor pressures. Its inertia should
low to make up for losses in carbon dioxide

- Voice-controlled robotic arm
1. Laparoscopic unit
2. Electrocautery
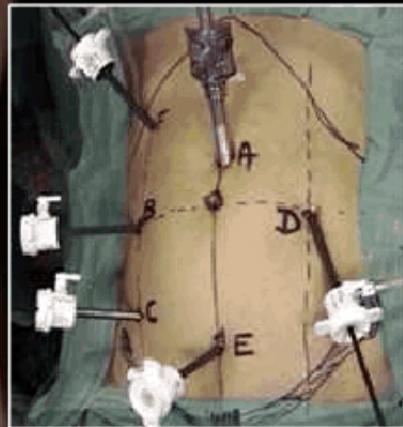3. Operating table
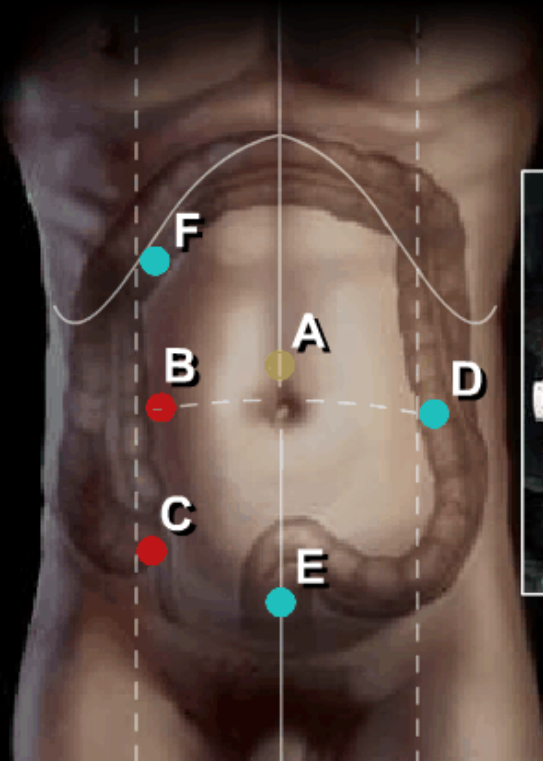
Shoulder Support

>Shoulder supports

To prevent the patient from sliding, shoulder supports or straps around the thorax may be used.
In our current practice, we rarely use such measures, despite a 20° to 30° Trendelenburg position and a right tilt.

Port Position

Although a sigmoidectomy can be performed using only 3 trocars, for complicated presentations and especially when the surgeon's experience in performing the technique is limited, the use of more trocars is preferable. This helps to ensure the safety of the procedure by allowing improved exposure of the operative field and the mesentery, and by facilitating mobilization of the splenic flexure.

We readily use 6 trocars, with a trend toward reducing trocar size. The patient's body habitus, previous history and the initial laparoscopic exploration via supraumbilical trocar should be used as guides fo introducing the various operating trocars.

Port Position
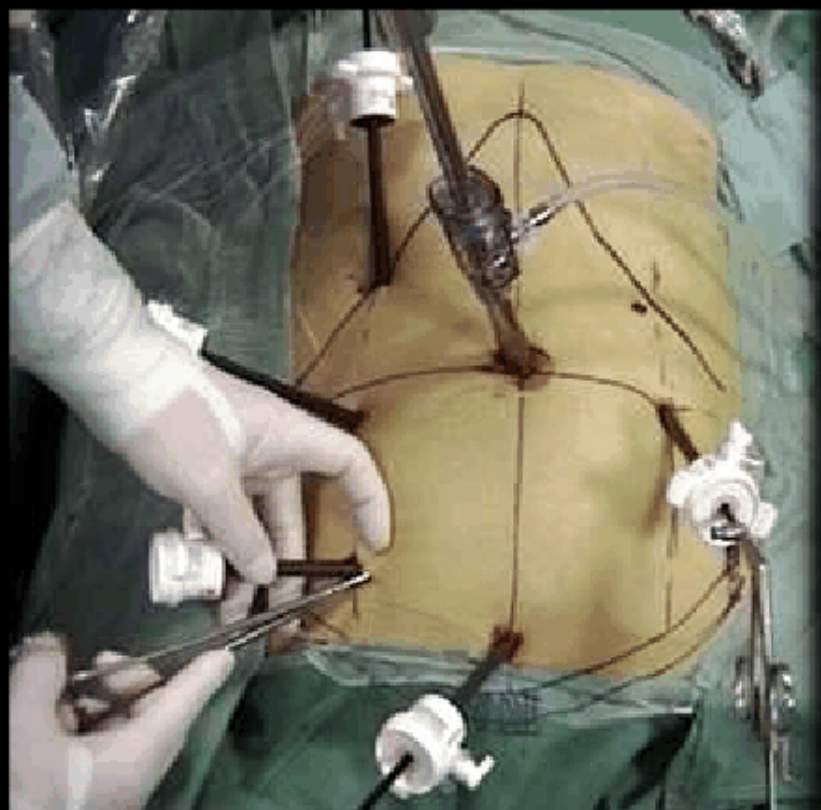
Firm trocar fixation in the wall is important. This is achieved by adapting the size of the incision to the trocar and, if needed, fixing the trocar to the abdomen with a suture. We no longer use screw-like devices, as they increase parietal trauma.
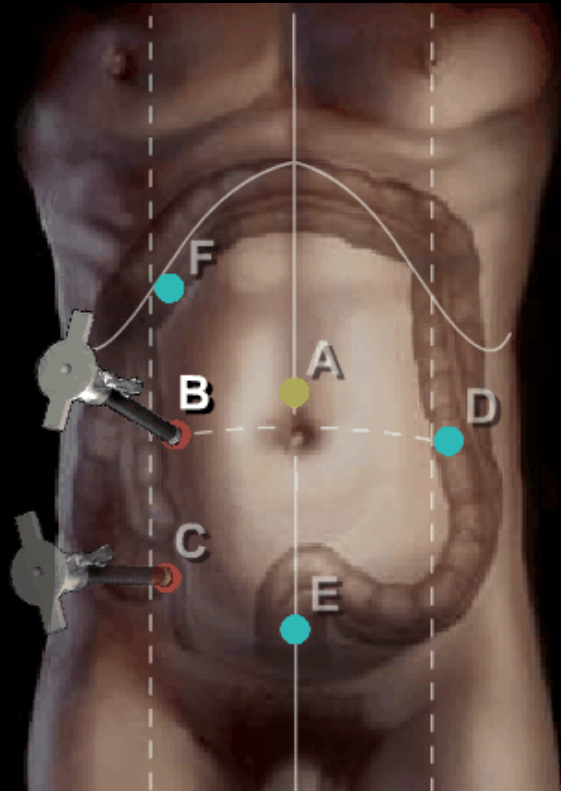
Optical Port
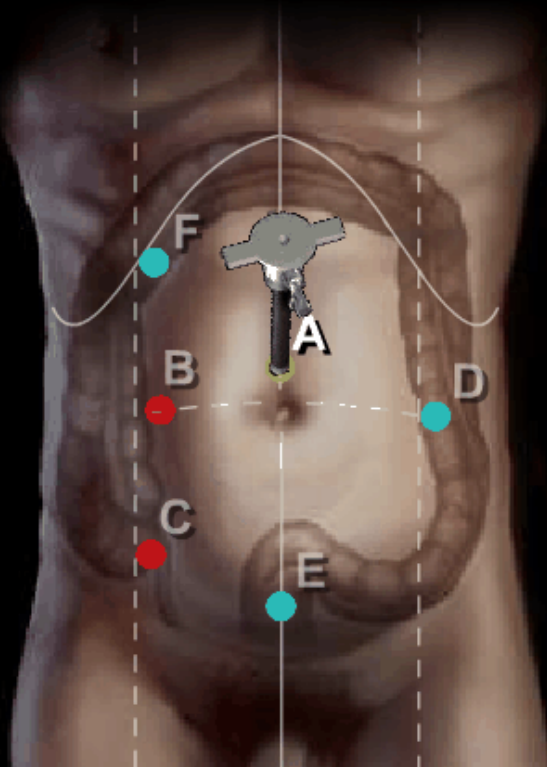
Trocar A: 10/12 mm, 0° optical
The trocar is positioned on the median line 3 to 4 cm
above the umbilicus or 20 cm above the pubis in patients
with a small stature.
This trocar accommodates a 0° optical.

Working Ports

This is a 5 mm operating trocar, used for retraction during mobilization of the splenic flexure (caudal retraction of the left colon), during which time trocar D is used for operating instruments. At the end of the procedure, Trocar B may be replaced by a 12 or 15 mm trocar for introduction of a linear stapler.

It is situated on the right midclavicular line, at the level of the umbilicus.

This trocar accommodates an atraumatic grasper.

Exposure
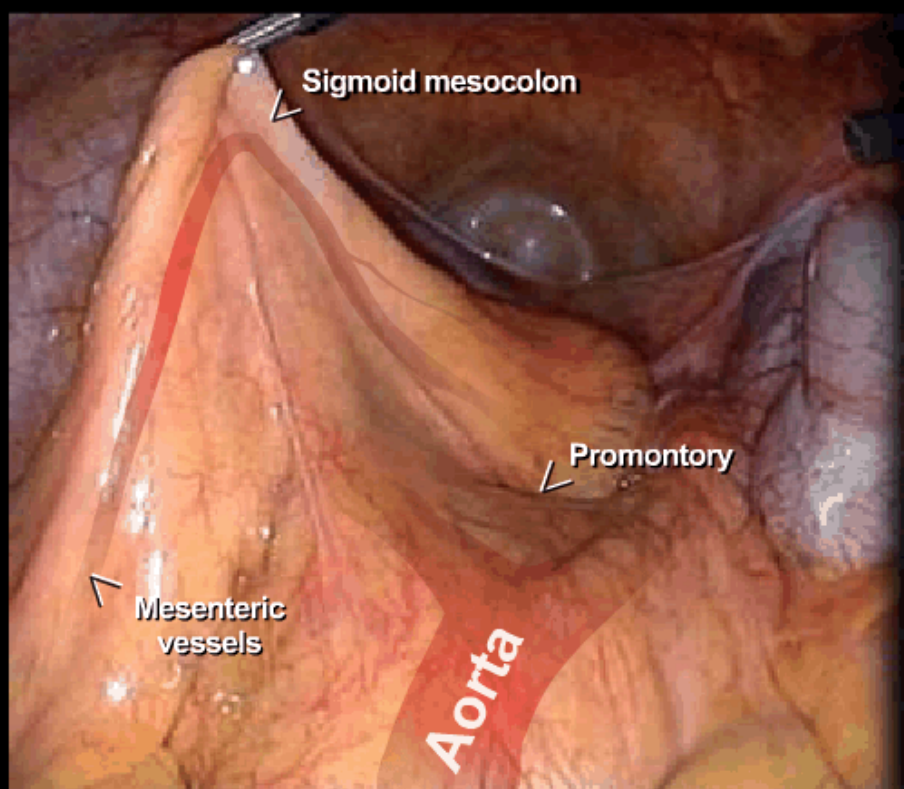
Improved exposure greatly facilitates the surgical procedure.
Proper exposure is a function of a host of factors.
These include the working space in the abdominal cavity, the quality of the preoperative gastrointestinal (GI) preparation, the positioning of the patient as well as a perfect understanding of the organization of the operating field.

Working Space
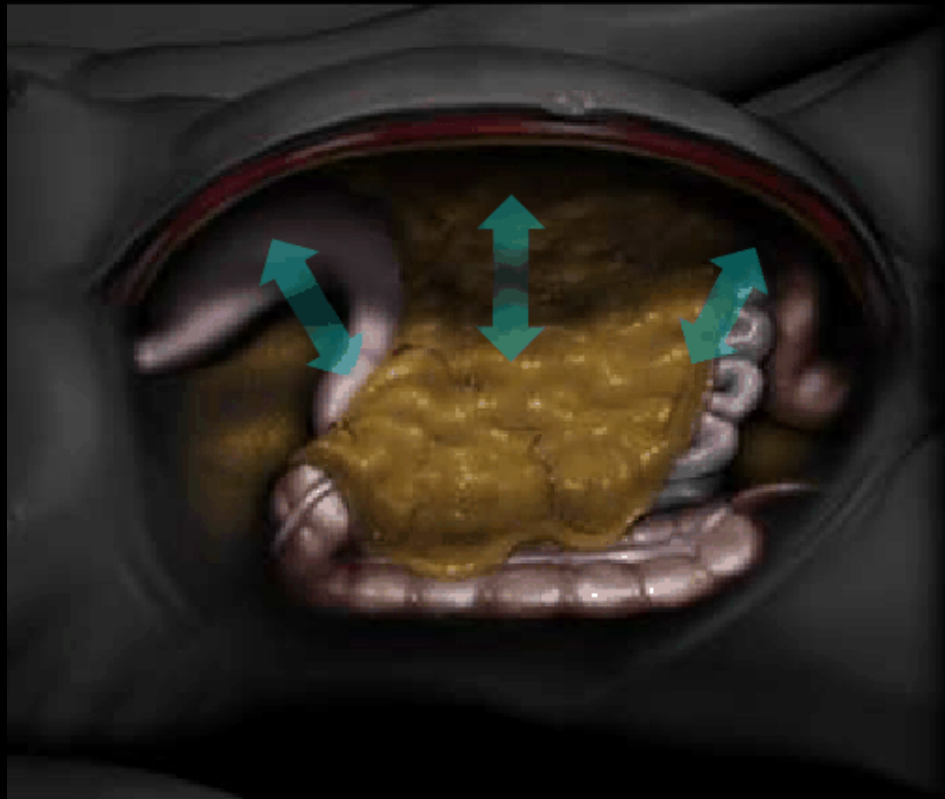
The working space depends on the quality of the preoperative GI preparation, the positioning of the patient and complete relaxation allowing the abdominal wall to distend correctly under the pressure of the pneumoperitoneum.

Fixation of uterus
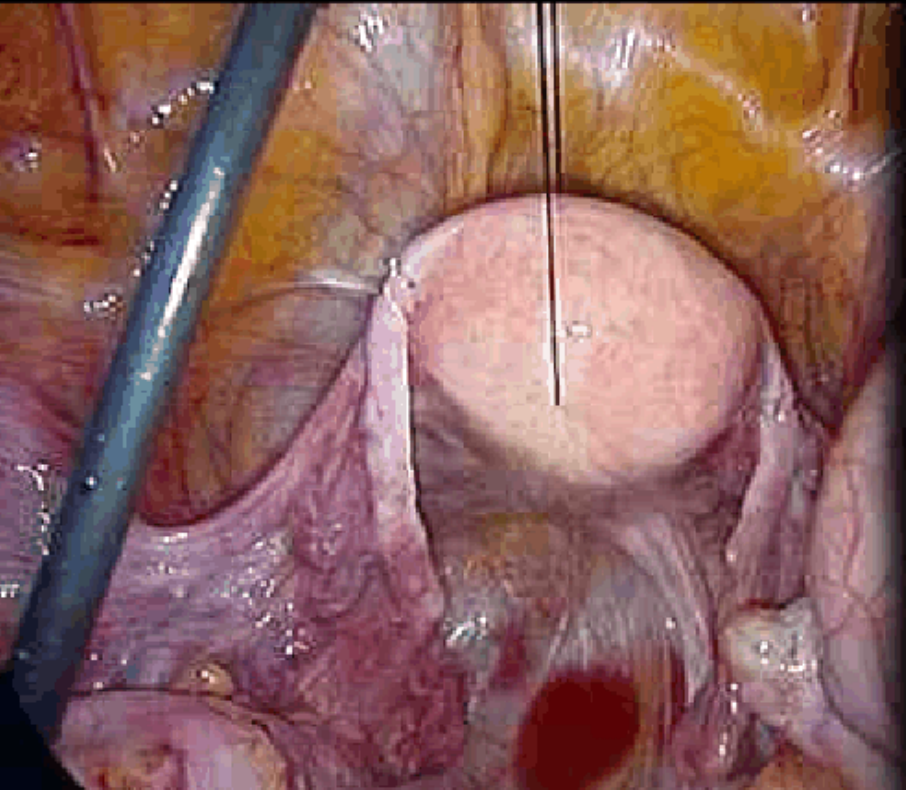
The uterus may be an obstacle to adequate exposure in the pelvis. In postmenopausal female patients, the uterus can be suspended to the abdominal wall by a suture. This suture is introduced halfway between the umbilicus and the pubis to suspend the vagina and make it horizontal, thereby opening the rectovaginal space.

Dissection
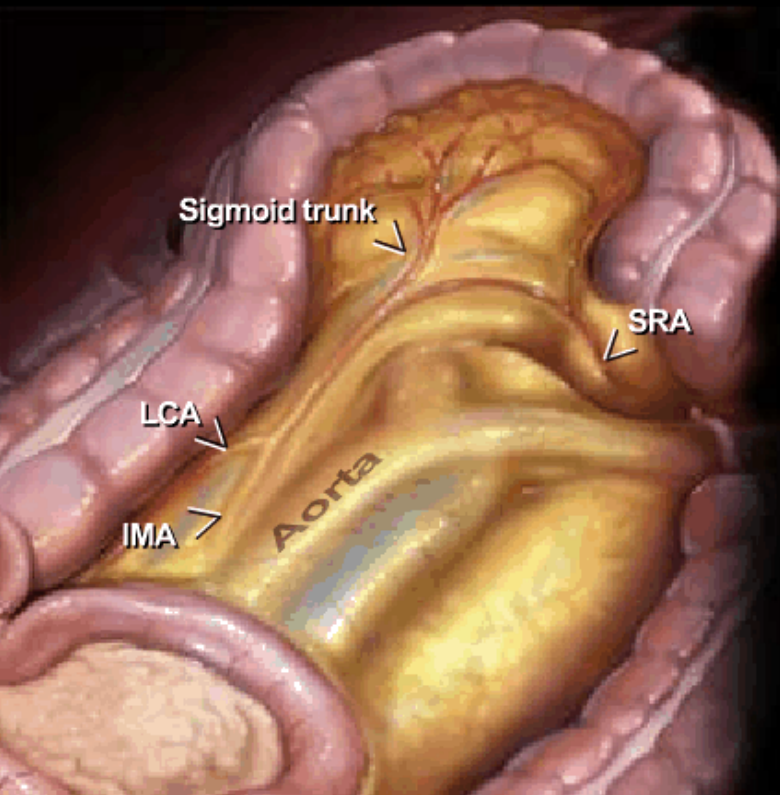
The initial vascular approach makes it possible to dissect the sigmoid mesocolon posteriorly and medially without manipulating the colon and the tumor. It must be associated with a lymphadenectomy, removing the lymph nodes of the inferior mesenteric chain.
Except in simple cases where vessels are visible due to transparency, the vessels are gradually exposed once the peritoneum of the sigmoid mesocolon has been widely opened.
Before dividing the vessels, it is important to identify the sympathetic nerve plexus trunks and the left ureter in order to preserve them.

Opening of peritoneum
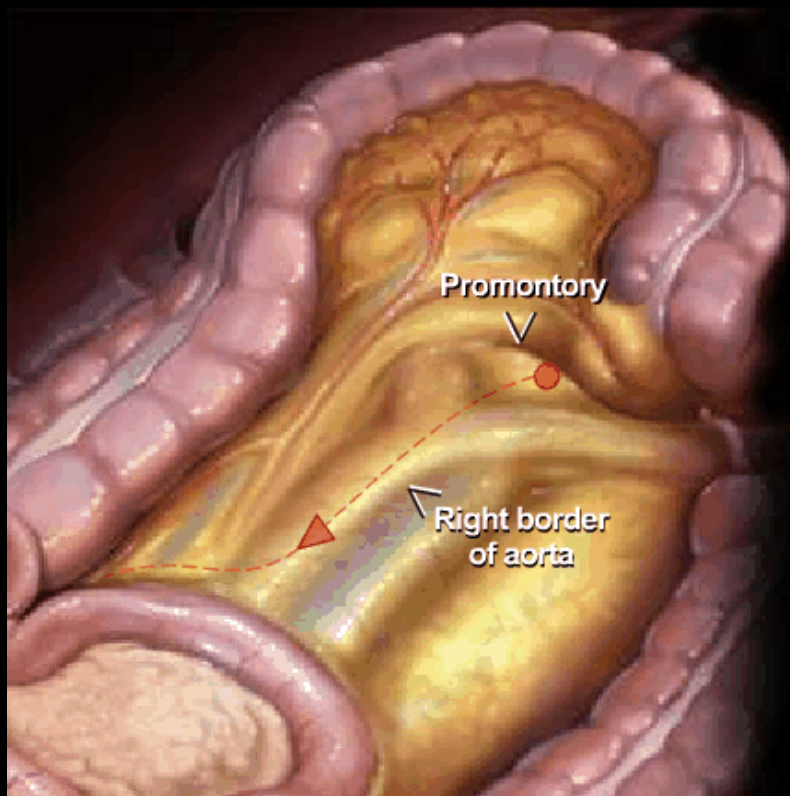
The peritoneum is opened upward along the right anterior border of the aorta, starting the incision from the promontory and extending it to just below the third portion of the duodenum.

Anterior traction of the sigmoid mesocolon, using a grasper introduced through trocar E, exposes the base of the sigmoid mesocolon. The pneumodissection (entry of CO_2 into the retroperitoneal space), which results from the pneumoperitoneum, facilitates the dissection.
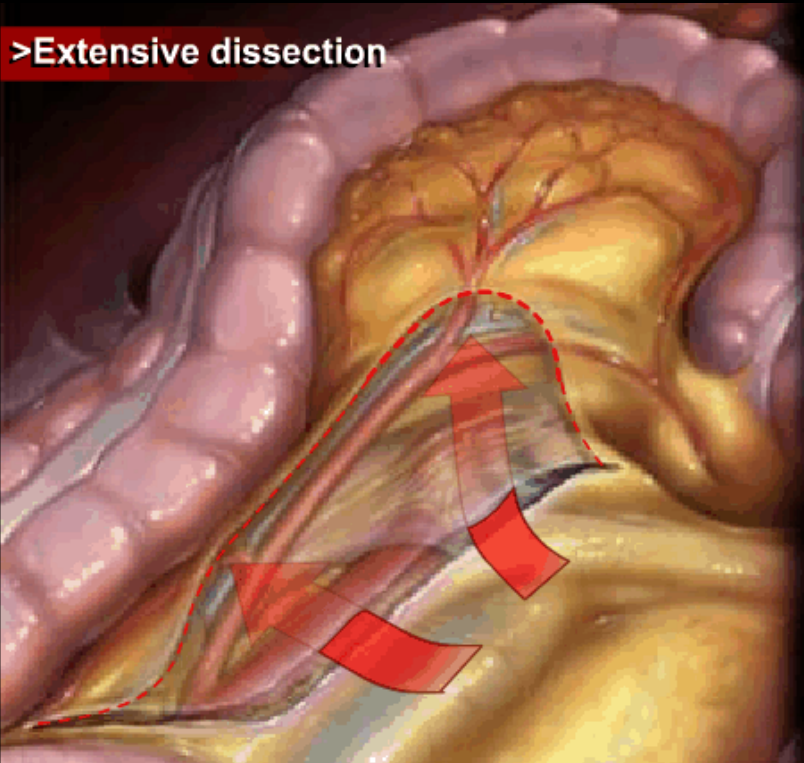
Dissection of fatty cellular tissue
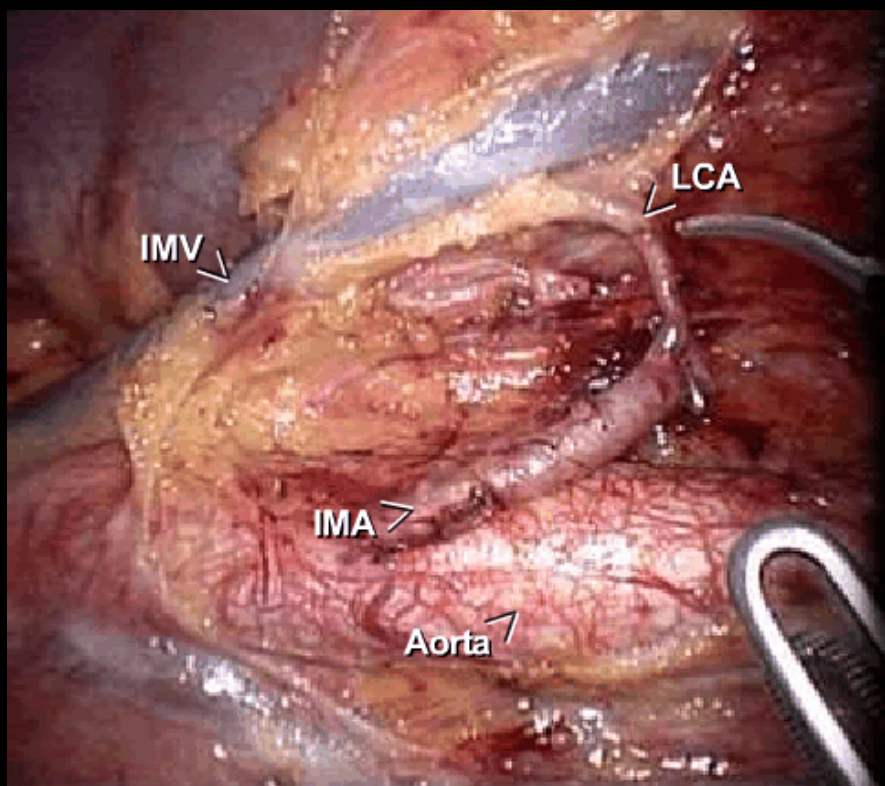
Dissection of the fatty cellular tissue is pursued upward and from right to left by gradually dividing the sigmoid branches of the right sympathetic trunk to expose the origin of the IMA.
This operative step is essential as it allows a safe dissection of the IMA at its origin.

Dissection of Lymph node

>Extensive dissection

To remove the lymph node tissue, the IMA is dissected 1 to 2 cm in a circular fashion before clipping.
A more extensive dissection can also be performed. The IMA is skeletonized and the left colic artery is identified and isolated in order to be preserved.

Mobilization of Sigmoid Colon

Medial approach
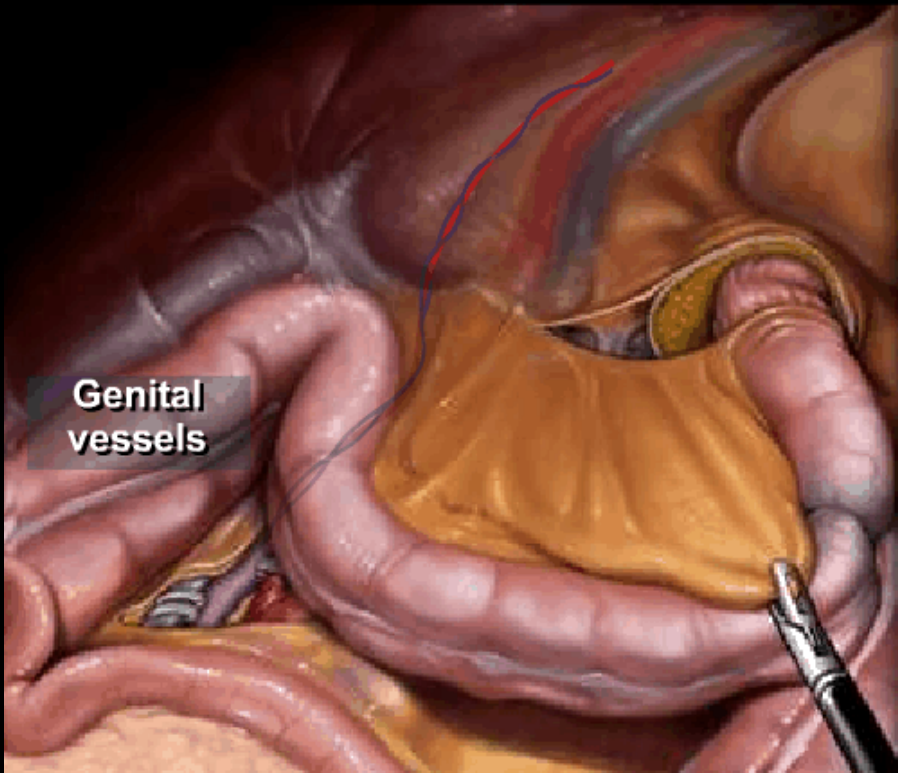
Base of sigmoid mesocolon

Toldt's line
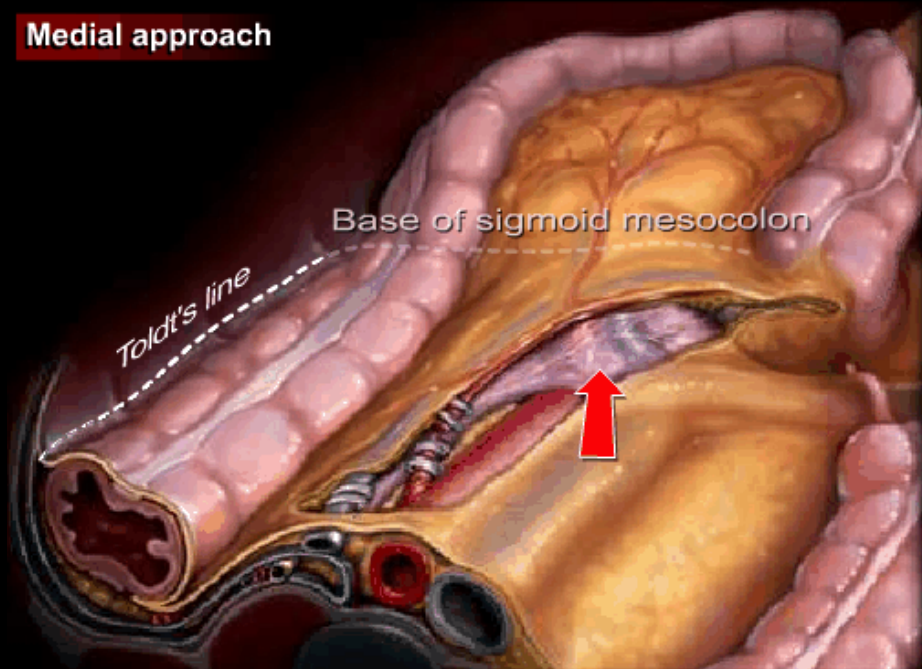
Mobilization of the sigmoid colon follows the division of the vessels.

This step includes the freeing of posterior and lateral attachments and the division of rectal and sigmoid mesenteries.

The approach is either medial or lateral. We prefer using the medial approach, except in thin patients whose sigmoid colon is very mobile. The medial approach is well adapted for laparoscopy as it preserves the working space and demands the least handling of the sigmoid colon.

Mobilization of Sigmoid Colon


Genital vessels

The sigmoid loop is pulled toward the right hypochondrium (grasper in trocar F) to exert traction on the left layer of the sigmoid mesocolon.

The base of this layer is opened toward the paracolic gutter and the pelvis. In case of adhesions of the sigmoid colon to the abdominal wall, this operative step can be difficult.

After incision of the left layer of the sigmoid mesocolon, the medially performed posterior detachment is joined. During this step, care must be taken to avoid genital vessels and the left ureter as they can be tethered by the medial pressure exerted on the mesentery. In case of difficulty, it is useful to combine with a medial posterior approach. Identification of the ureter with a ureteral catheter (luminous bougie or not) does not seem necessary to us.

Mobilization of Sigmoid Colon


10 cm

Tumor

5 cm
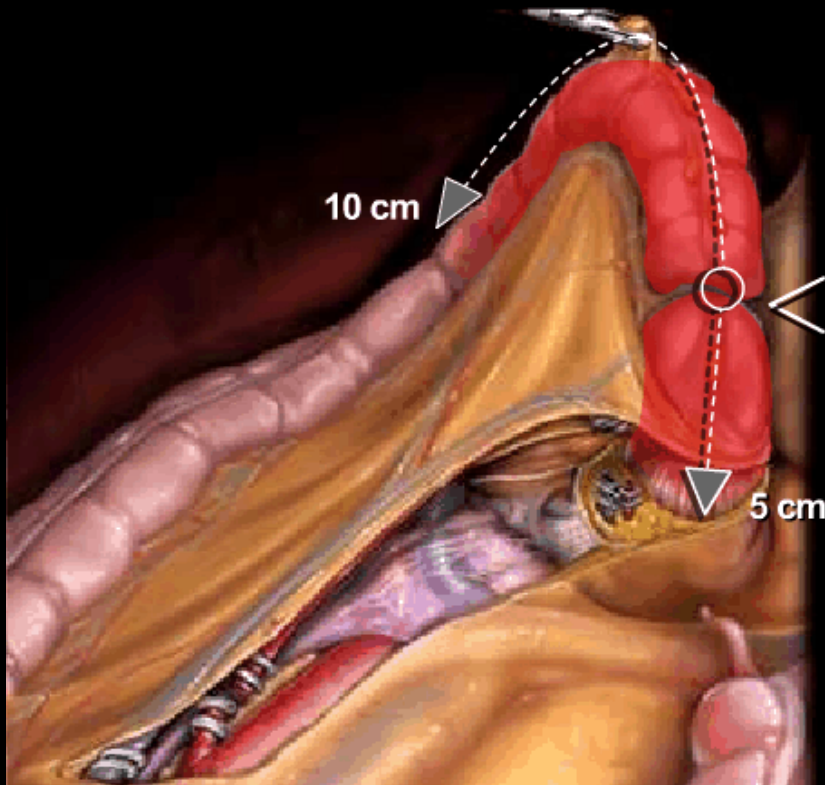
Once it is freed, the sigmoid colon is divided, at least 5 cm below the tumor and 10 cm above the tumor. This rule is applicable for long, supple sigmoid colons. Otherwise, complete sigmoidectomy must be performed down to the colorectal junction, or even down to the upper portion of the rectum for lesions of the distal portion of the sigmoid colon.

Mobilization of Sigmoid Colon
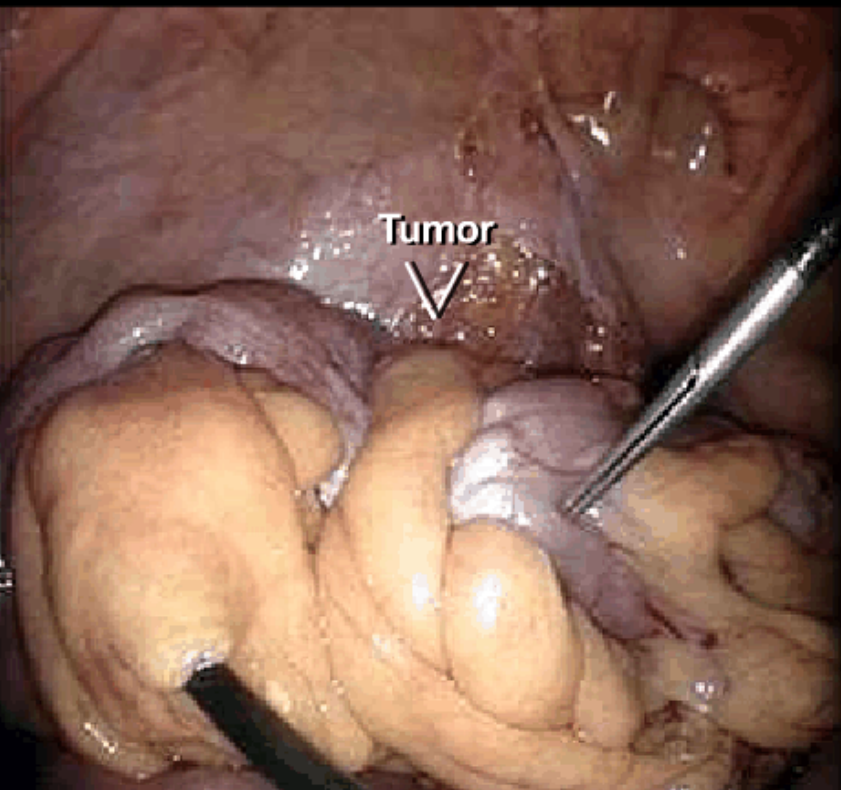
Tumor

Division of the rectum or the colorectal junction is performed at least 5 cm below the tumor, removing all of the surrounding fat. Exclusion of the colon below the tumor, just above the staple line, is advised. Lavage of the rectal stump can then be performed before dividing it with the stapler.
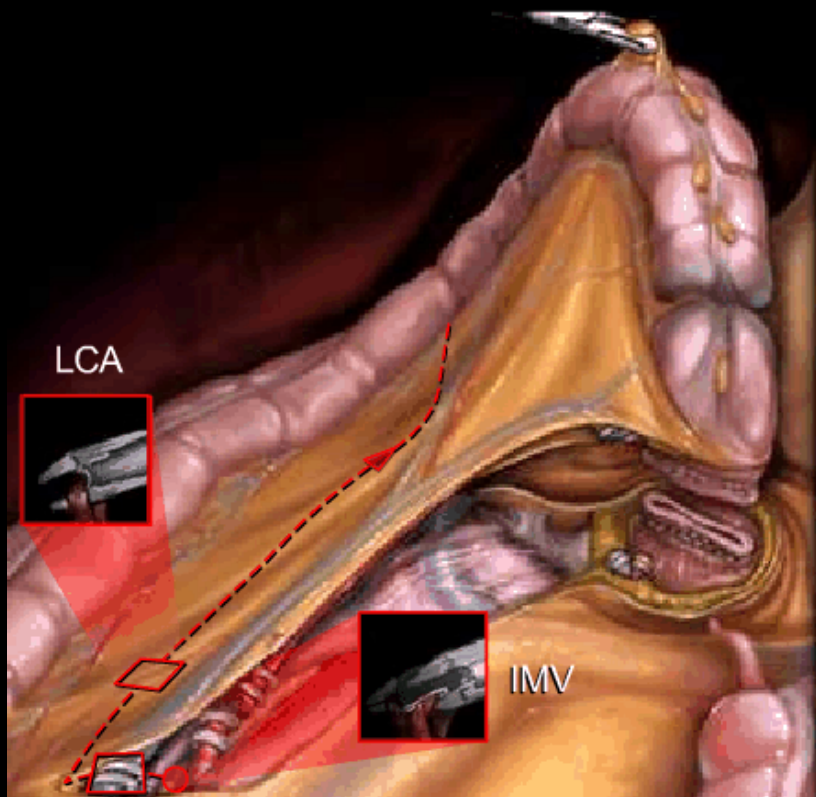
Mobilization of Sigmoid Colon
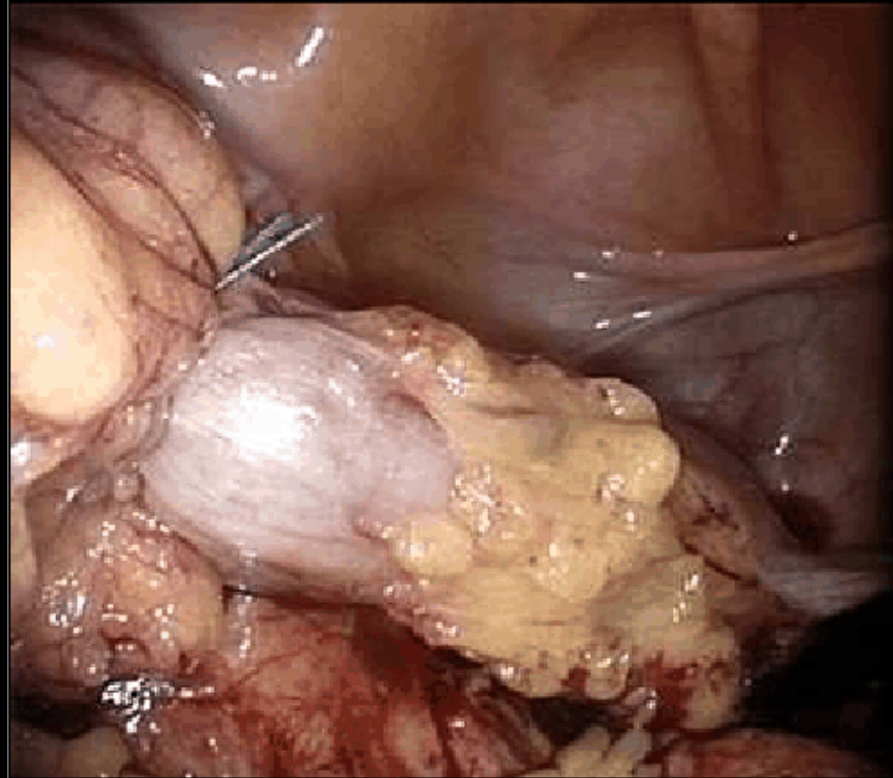
The freed distal portion of the sigmoid colon is excluded with either ligature, a clamp or a row of staples. The rectum is then washed with a saline solution or a solution with polyvinylpyrolidone iodine by introducing a cannula via the anal canal.
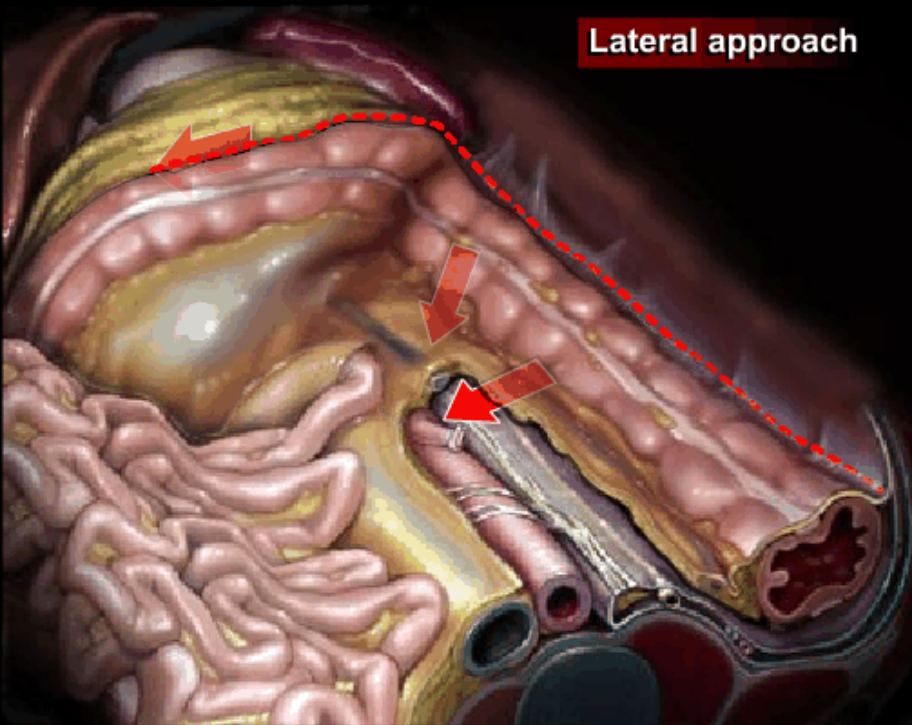
Division of Sigmoid Colon
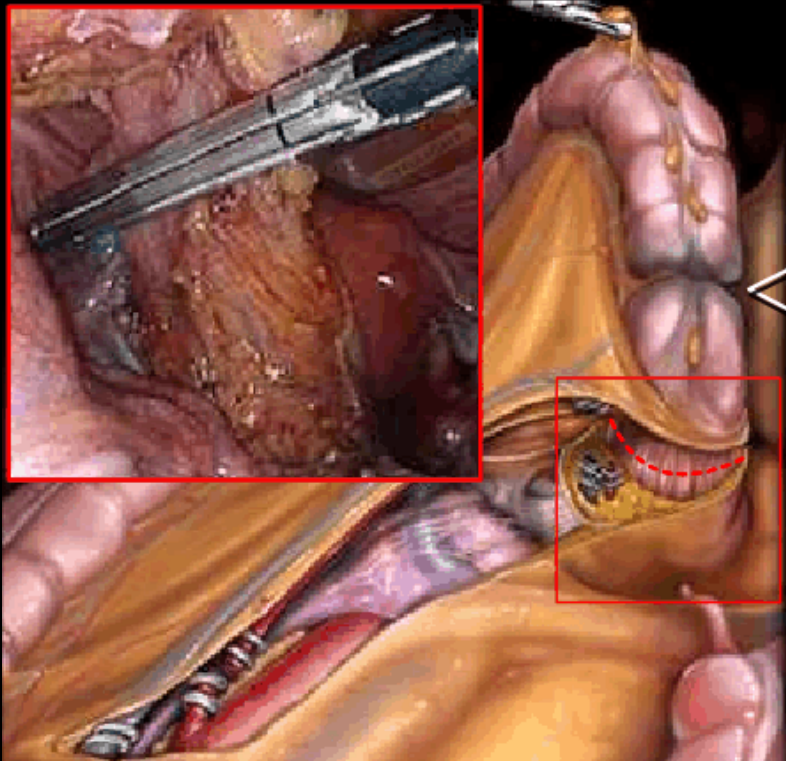
Tumor — Division is performed using a sharp suturing device to divide and staple without opening the digestive tract. The stapler is introduced through trocar C into the right iliac fossa. We prefer using staplers for thick tissues (green cartridges), which are applied perpendicular to the digestive tract. Staplers with adjustable angles can be useful.

Division of Sigmoid Colon

Division is performed with a high frequency hemostasis device, ultrasonic dissectors or linear staplers, removing the totality of the sigmoid mesocolon along with lymph nodes.

Division of Sigmoid Colon

Lateral approach

In the event that a long segment of sigmoid colon is resected, mobilization of the left colon is necessary to allow for a tension-free colorectal anastomosis.

The left colon is freed by division of its posterior and lateral attachments. Occasionally, division of the left colic vessels is required for full mobilization of the left colon. The vascular supply of the mobilized left colon should be preserved. This is often difficult to assess in laparoscopic surgery.

Mobilization of the splenic flexure is frequently required. This can be achieved in a number of different ways. It is important for the surgeon to be familiar with all these approaches in order to select the approach most suitable for each case.
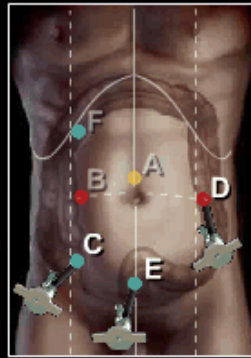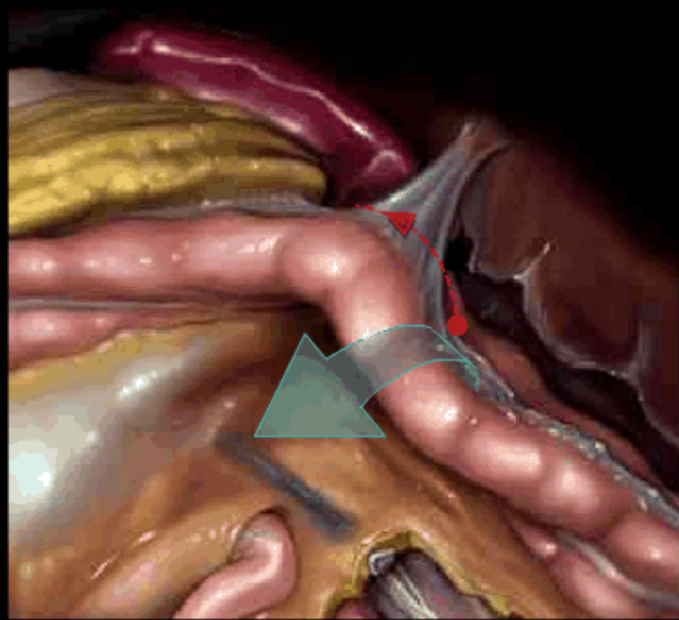
Dissection of proximal segment
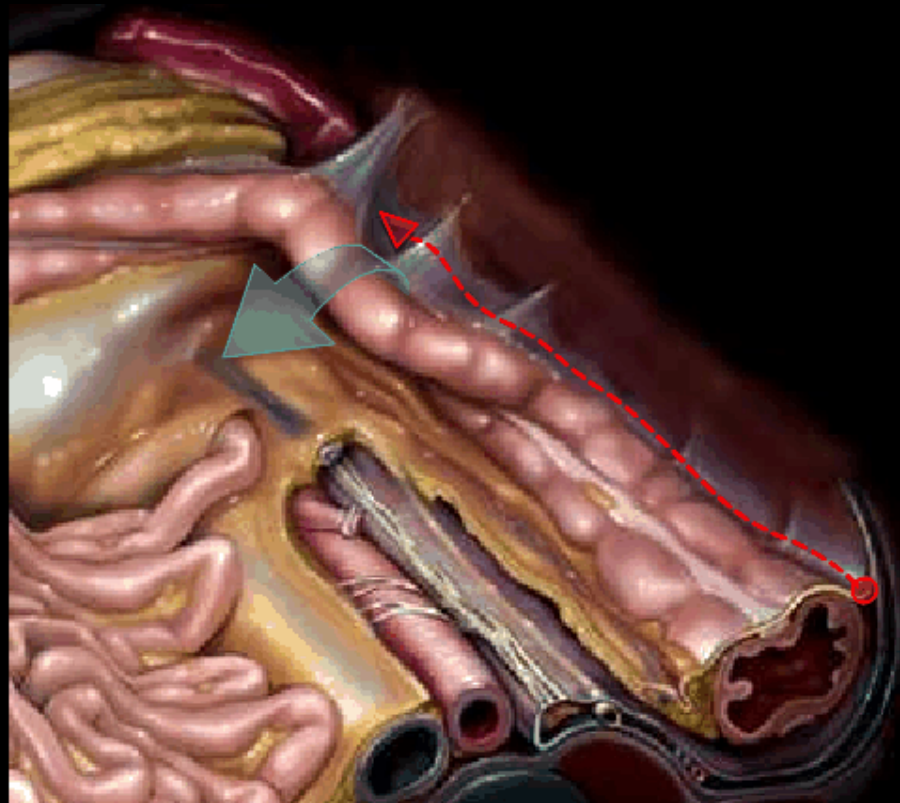

Toldt's line

An ascending incision is made along the white line of Toldt using scissors introduced via trocar D.

Dissection of proximal segment

The phrenicocolic ligament is then divided using scissors introduced through trocar D. Retracting the colon and the splenic flexure toward the right iliac fossa using graspers introduced through trocars C and E helps in this exposure.

# Dissection of proximal segment
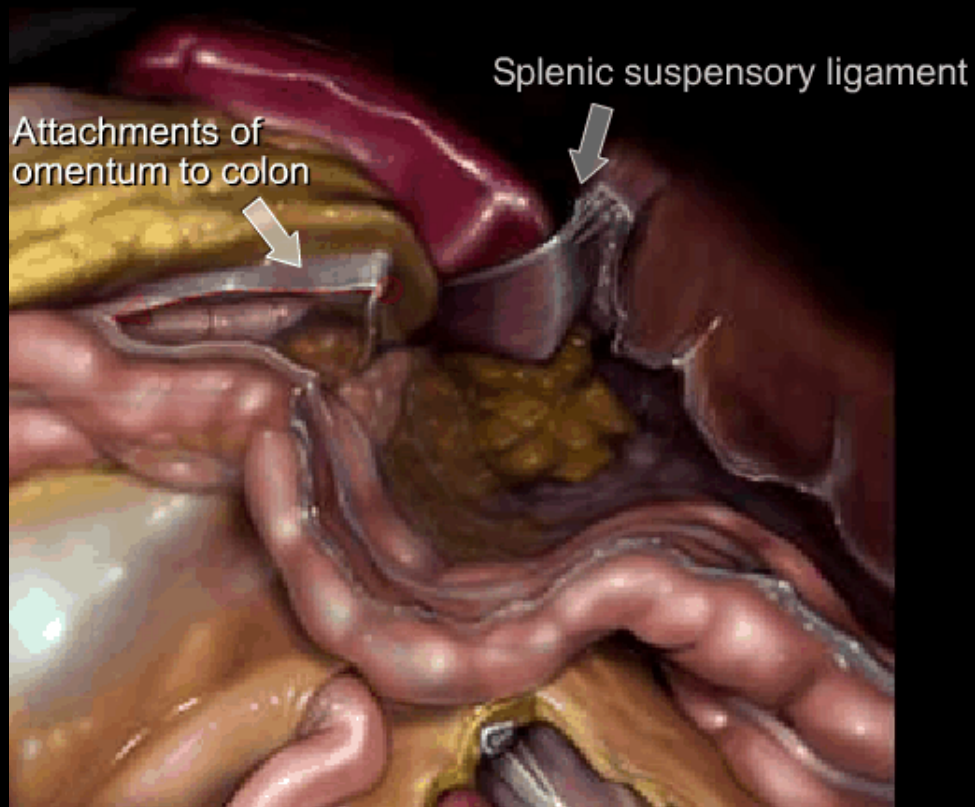
Attachments are incised close to the colon until the omental bursa (lesser sac) is opened. Division of these attachments is pursued as needed toward the right, to facilitate lowering of the left transverse colon.

Dissection of proximal segment
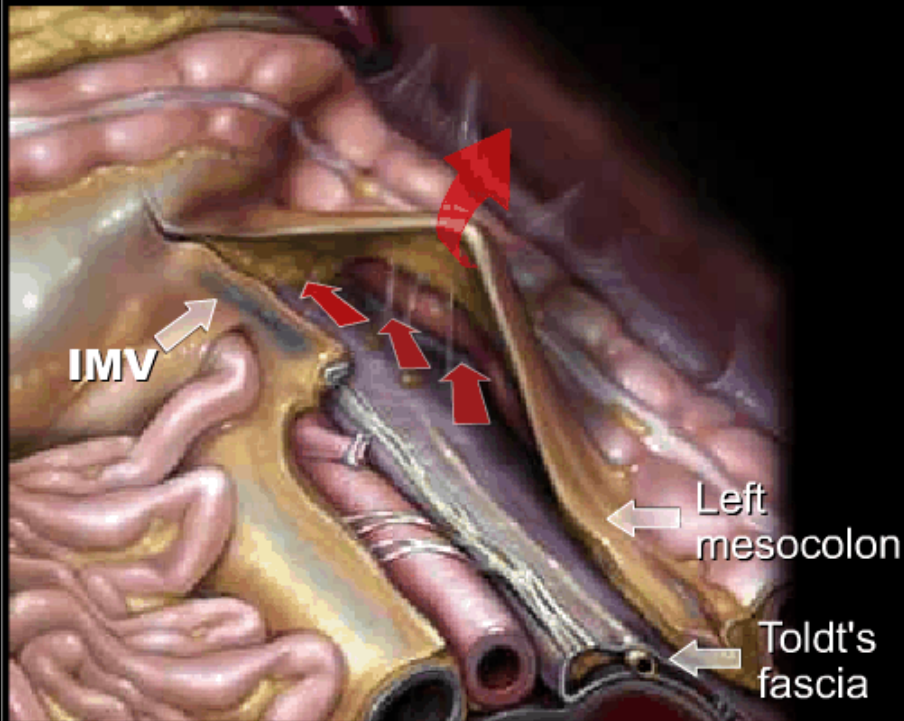
The splenic flexure is freed on its posterior surface while remaining close to the left mesocolon. This avoids the risk of a dissection posterior to the pancreas with an attendant injury of the splenic vein. Division of the IMV just below the inferior border of the pancreas facilitates this operative step.

Extra-abdominal preparation of proximal segment
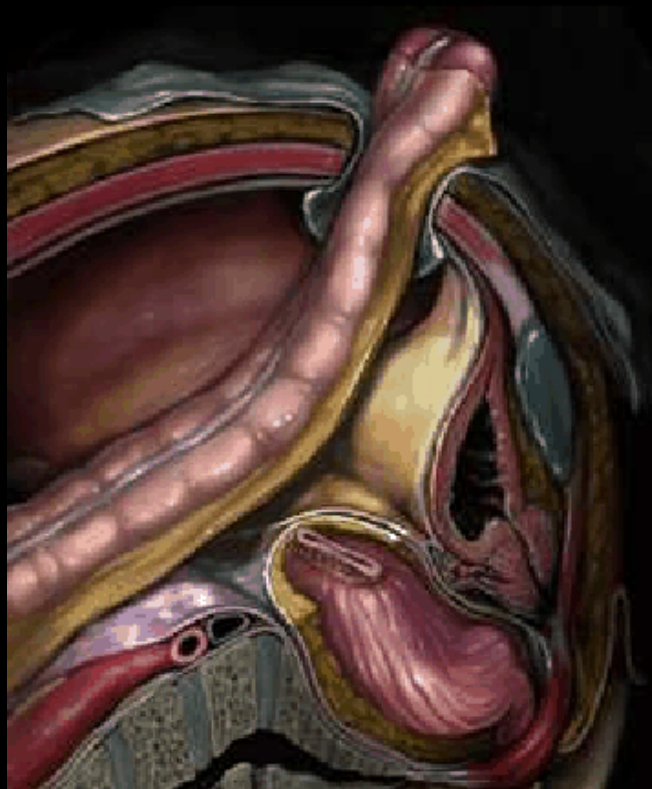
The colorectal anastomosis is a delicate step. We always use a mechanical circular stapling device to transfix the rectal stump.

Performing the anastomosis includes an extra-abdominal preparatory step and an intra-abdominal step performed laparoscopically

The extra-abdominal step takes place after exteriorization of the left colon through the incision protected by the plastic-coated drape.

Extra-abdominal preparation of proximal segment

The anvil is at least 8 mm in diameter.

If necessary, the colon is cut again in a healthy, supple and well-vascularized zone. The anvil (at least 28 mm in diameter) is then introduced into the colonic lumen and closed with a purse string. The left colon with the anvil is then reintroduced into the abdominal cavity.

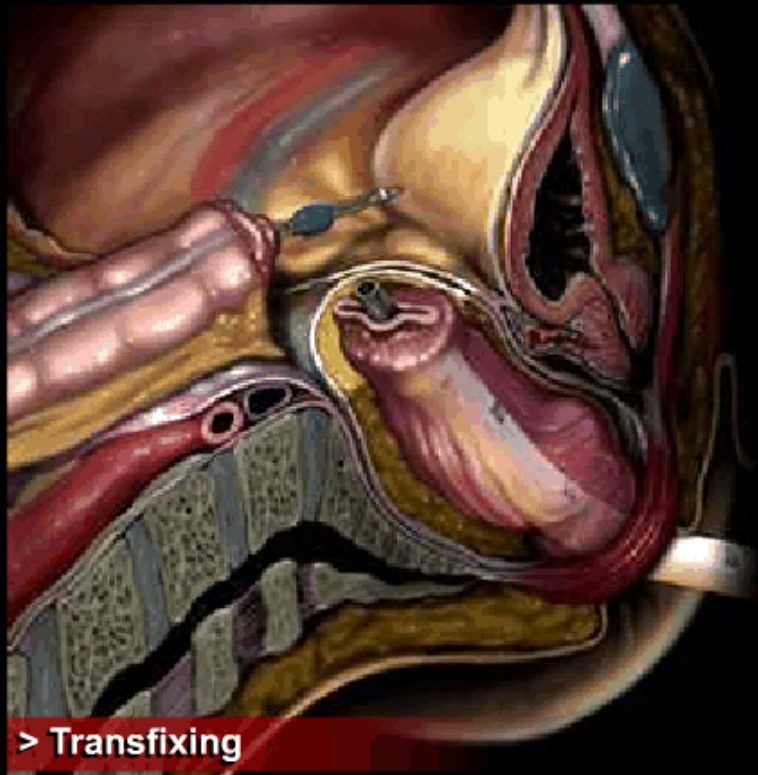# Extra-abdominal preparation of proximal segment
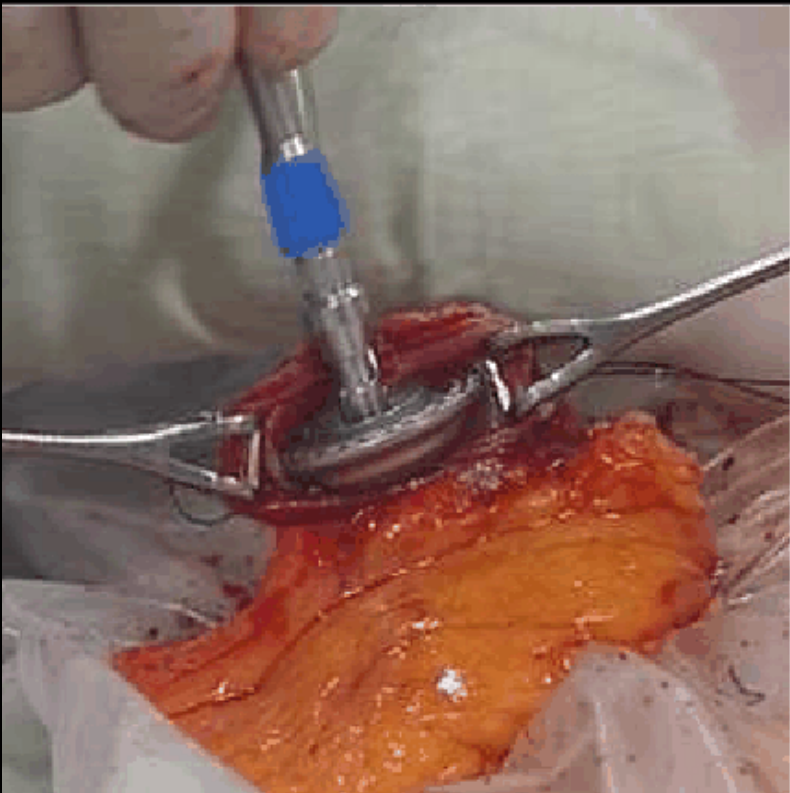
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Anastomosis

The intra-abdominal step is performed entirely under laparoscopic guidance after reinflation of the abdominal cavity. It includes transfixing the rectal stump and performing the colorectal anastomosis with a circular mechanical stapler.
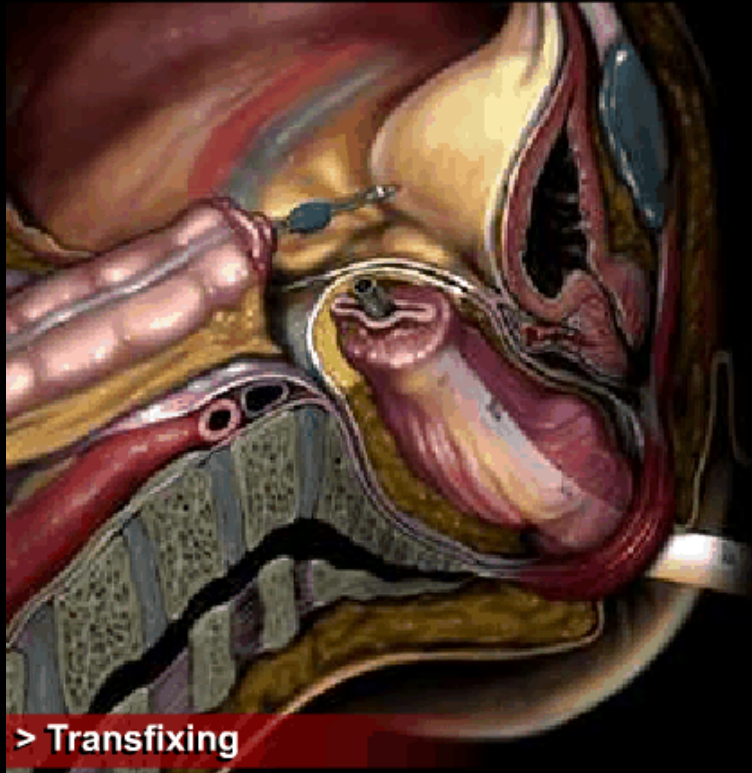
Anastomosis

> Transfixing

After ensuring that the abdominal cavity is airtight, the pneumoperitoneum is reestablished. The circular stapler is introduced into the rectum through the atraumatically dilated anus. The rectal stump is then transfixed with the tip of the head of the circular stapler.

To avoid ischemic risks, the stapler can be introduced in the middle or at one of the ends of the rectal stump staple line while avoiding leaving lateral ear-shaped flaps.

In women, the posterior vaginal wall should be retracted anteriorly.

Anastomosis

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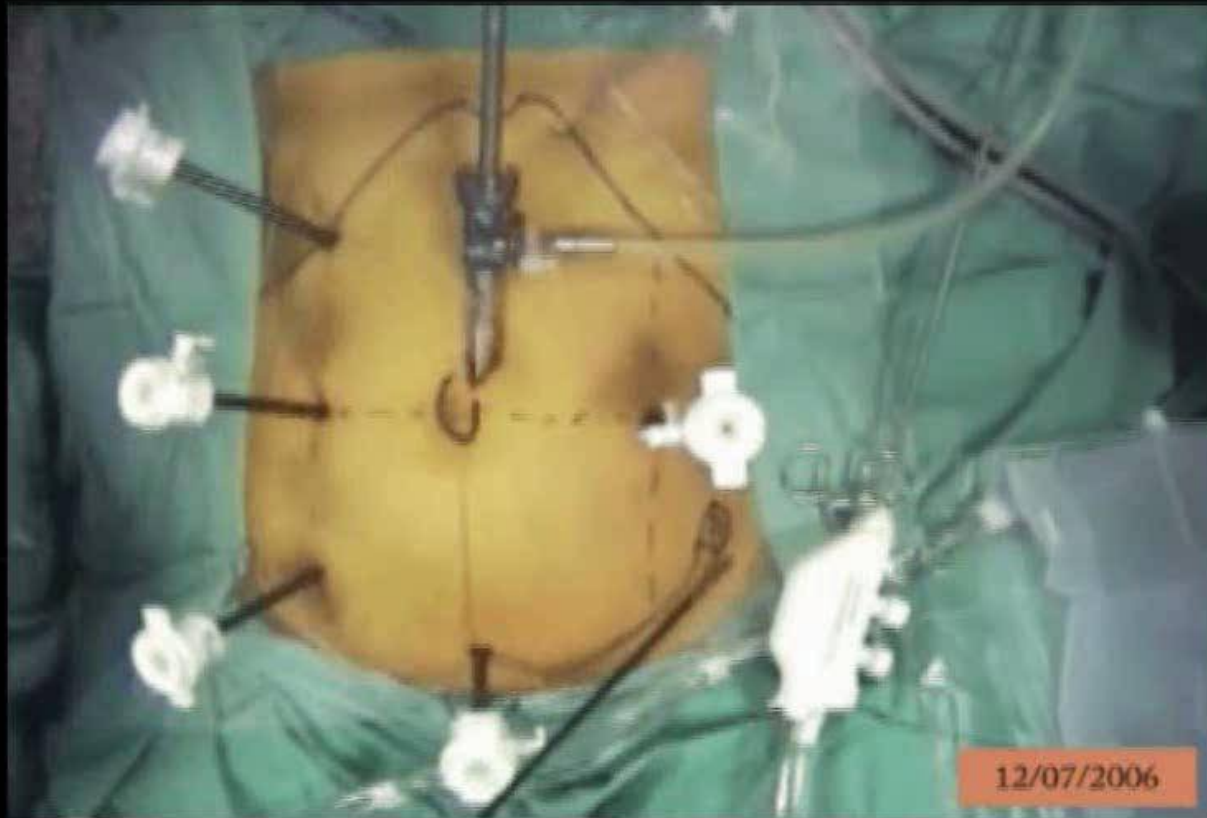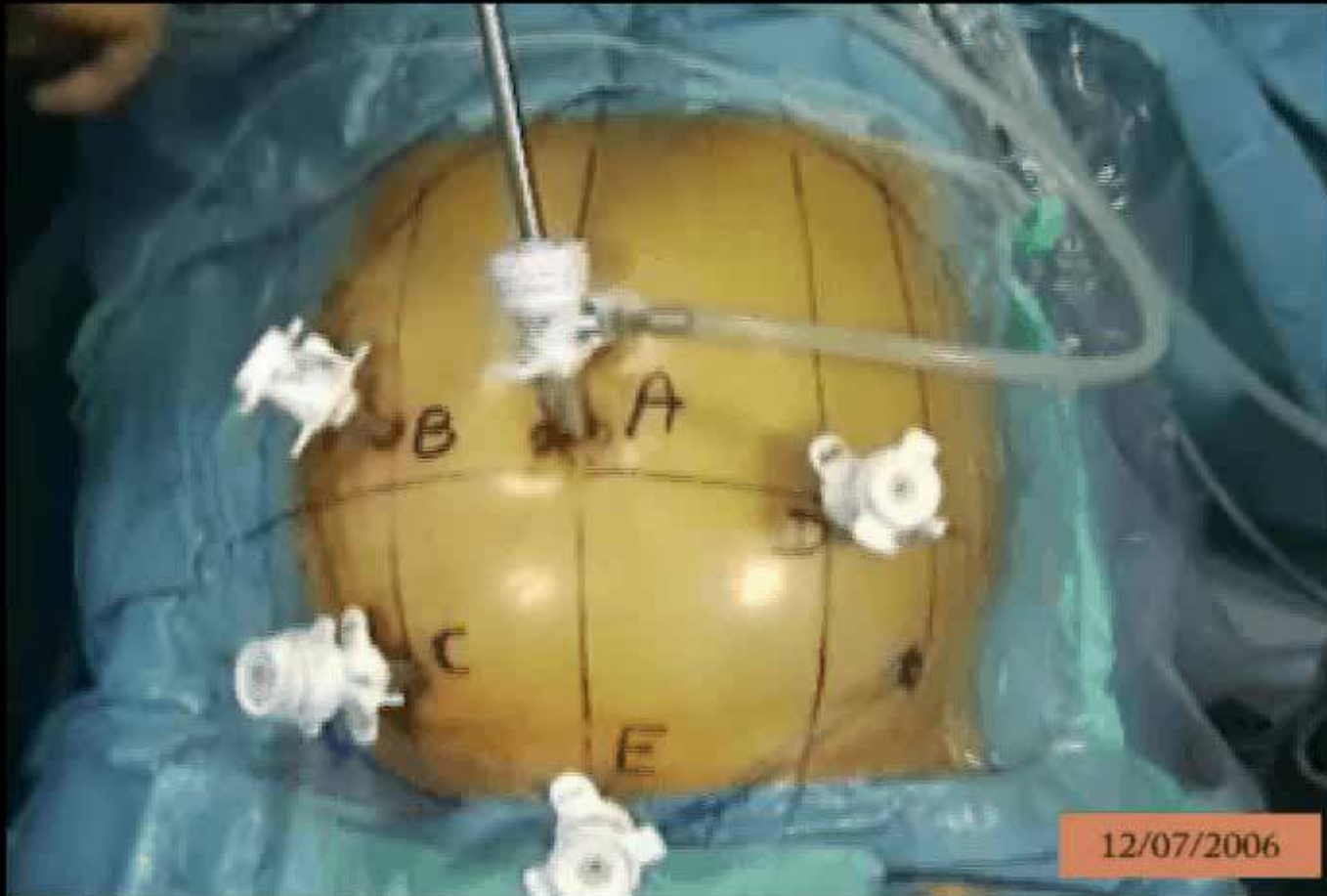
Anastomosis

> Anastomosis

Once the anvil has been clicked onto the proximal part of the circular stapler, it is mandatory to ensure that the proximal part of the colon is not twisted. The stapler is then closed; the surgeon should check that no neighboring organs are incarcerated before stapling in accordance with the manufacturer's recommendations. The stapler is then loosened and withdrawn through the anus.

Laparoscopic Low Anterior Resection

12/07/2006

Laparoscopic Sigmoidectomy

Complications of Sigmoidectomy

- Wound infection

- Anastomotic leakage

- Bleeding

- Ureteric Injury

- Cardiopulmonary failure

- Pneumonia and

- Renal failure