CHAPTER 11
Surgical treatment: surgical technique

For the purposes of this report, we will not cover all the techniques in detail, but will briefly describe the two main types of colectomies (right and left), taking into account that they can be performed by conventional open approach, by uniportal, multiportal, or hand-assisted laparoscopic approach, and by robotic approach.

Preoperative evaluation

Standard evaluation of a colectomy includes general clinical and cardiovascular evaluation (arrhythmias or asymptomatic cardiovascular pathology), anesthetic evaluation according to the ASA classification, humoral evaluation (general, hemostasis, renal function, proteinogram, tumor markers, Rh factor and group) and specific evaluation of the pathology (colonoscopy, CT, MRI, PET-scan). Likewise, the risk of thrombosis must be assessed pre-, intra- and postoperatively, according to the characteristics of the patient, the pathology and the surgical procedure to be performed.

Bowel preparation

This is an aspect that has undergone great changes in the last decade, from total preparation to no preparation at all. Current ERAS (enhanced recovery after surgery) protocols suggest not preparing the bowel in elective left colectomy, except when an extraperitoneal colorectal anastomosis is required.

Preparation will also depend on the pathology to be treated. In the case of early or small polyps and tumors, bowel preparation is suggested given the possibility of requiring an intraoperative colonoscopy due to the difficulty of locating the lesion if it was not tattooed. Whenever possible, it is important to tattoo the site within a period of no more than 30 days after resection.

In advanced non-obstructive tumors, surgery can be performed with a single preoperative enema, without laxative. However, in an obstructive tumor and depending on the clinical condition of the patient, endoscopic placement of a colonic stent should be considered to resolve the acute event and schedule subsequent surgery. If a colonic stent is not available, the patient should be operated on without any bowel preparation. If bowel preparation can be used, polyethylene glycol-based preparations are suggested.

Tip – Following the ERAS protocol, there is a tendency to perform a less aggressive bowel preparation and not to suspend the diet or prescribe only a liquid diet, except in rectal surgery.

Antibiotic prophylaxis

It is necessary to systematically assess the possible allergy to antibiotics and analgesics or non-steroidal anti-inflammatory drugs during the anamnesis. Currently, the prophylaxis suggested by any ERAS protocol includes the combination of antibiotics for Gram-negative and anaerobic germs, administered orally the day before and on the day of surgery. This prophylaxis is reinforced during anesthetic induction with the same regimen and should not exceed one postoperative dose.

Antithrombotic and antitetanus prophylaxis

Tetanus prophylaxis is no different than for any elective surgery. In laparoscopic left colectomy, the use of stockings for the entire lower limb and intermittent pneumatic compression boots with a pump is suggested during surgery and in the postoperative period while the patient is at rest to prevent deep vein thrombosis. The use of pharmacological thromboprophylaxis follows the protocol of each institution and international standards according to the risk of each patient.

Anesthesia

General anesthesia with endotracheal intubation, with or without regional spinal block and with or without transversus abdominis muscle block, is the standard option. Postoperative analgesia may be intravenous, by transversus abdominis muscle block, or by placement of a spinal catheter that will serve for the first 24 hours.

Patient position

The modified Lloyd-Davies position is used with the legs semiflexed, with the perineum free to allow access for endoanal circular suturing, intraoperative colonoscopy, or rectoscopy for hydropneumatic testing. Recently, this access has been included for endoscopic control of the colorectal anastomosis. For right colectomy, although this position can be used, the usual position is supine.

Bladder catheterization is indicated in prolonged surgeries, to protect the bladder during the placement of trocars in the hypogastrium or to empty it and avoid its interposition in a minor pelvic approach. The patient is fixed to the operating table with a non-slip surface and shoulder and pelvic fixation elements, with bilateral protection. In our experience, we suggest positioning both upper limbs at 60-90º to facilitate access.

It is important to protect the decubitus and fixation areas of the upper and lower limbs in order to avoid passive nerve compression and postoperative functional neurological syndromes that may become permanent or require muscle-aponeurotic decompression due to compartment syndrome.

The position is dynamic and depends fundamentally on the anatomical location of the organ and the time of surgery. The usual position is a forced variable Trendelenburg position and rotation to the right side. This position facilitates the visualization of the area to be treated and the displacement of the viscera that interfere with the approach to the pathology.

Surgical team

In conventional right colectomy, the surgeon is located on the right side of the patient and the two assistants on the left side. The opposite occurs in laparoscopic right colectomy, where the surgeon is located on the left side, or between the legs of the patient, and the assistant with the camera is located on the left side next to the surgeon. Usually only one assistant is needed; if another is needed, the position will depend on the location of the accessory trocar.

In conventional left colectomy, it is usual for the surgeon to be located on the left side and the assistants on the opposite side. For laparoscopic left colectomy, the surgeon is located on the right side of the patient, with the first assistant (camera) on the same side, to the left of the surgeon. The second assistant is located on the left side of the patient, provided that a fourth ipsilateral trocar is placed. The scrub nurse is located to the right of the surgeon. In the absence of articulated arms, the laparoscopy tower is located towards the patient's left lower limb diagonally to the

surgeon and the energy platforms behind the surgeon, if wireless technology is not available.

Necessary surgical instruments

In the conventional approach, the instruments are those usually used for major abdominal surgery. In the laparoscopic approach, a 30º optic is used. The instruments consist of atraumatic intestinal grasping forceps, forceps for dissecting vascular elements, metal or polymeric clips, and energy devices for dissection and treatment of the mesentery and vessels (vascular sealant, harmonic scalpel, or monopolar dissector). In addition, at least two universal staplers must be available in case of malfunction or jamming of the device. The available cartridges, articulated or not, must be of variable thickness and length depending on the case and the height of the section of the rectum. The more distal the rectum is divided, the more necessary the articulated cartridges are. The circular suture for colorectal anastomoses is a constant element. Bougies must always be available to dilate the rectum prior to the introduction of the stapling device and the rectoscope to perform the hydropneumatic test. Recently, the use of a colonoscope has been recommended to monitor the anastomosis under direct vision and treat any occult bleeding.

Tip – Bring all necessary instruments with you. Having spare staplers and alternative cartridges will ensure the success of the surgery.

Laparoscopic surgery in steps

The common step for both right and left colectomies is the creation of pneumoperitoneum and initial exploratory laparoscopy.

- Creation of pneumoperitoneum:
The placement of the Veress needle or umbilical trocar must be performed with the appropriate technique to avoid visceral or vascular injuries, especially in patients with abdominal distension or previous surgeries. If possible, it is always advisable to perform transillumination of the wall to avoid injuries to the inferior epigastric vessels during the placement of the lateral trocars.

Tip – Perform pneumoperitoneum according to the instruments and experience of the surgical team.

- Exploratory laparoscopy:
Once the first trocar has been placed, we suggest performing an exploratory laparoscopy and evaluating the placement sites of the other trocars based on the anatomy of the peritoneal cavity, the abdominal wall (previous scars) and the pathology to be treated. In this step, signs of secondary involvement (peritoneal carcinomatosis, free fluid, liver or other organ metastases) should also be sought. Tumors should be located by their size or fixation to neighboring organs, and tattoos and adhesions to the wall and omentum should be identified.

Tip – Always initial exploratory laparoscopy.

RIGHT COLECTOMY

- Trocars. Arrangement and variations:
The first 10-12-mm trocar is used for the initial placement of the camera that will guide the placement of the remaining portals under direct vision. This trocar can be placed after performing the pneumoperitoneum with a Veress needle, or using an open technique. After placing the first trocar, it is suggested to explore the abdominal cavity and evaluate the type of colon (dolicho, mega or short colon), its corresponding meso and the greater omentum, looking for adhesions (postoperative or secondary to the underlying pathology) that could interfere with the placement of the other trocars and proceed to their release.
Right colectomy is probably the one with the greatest individual variation in trocar placement, depending on the surgical team. We will describe the one most commonly used by our team. The first umbilical trocar assists in the placement of the second trocar (5- or 10-mm depending on the available instruments) in the right iliac fossa, for the left hand and the third trocar (5- or 10-mm) in the hypogastrium, left iliac fossa or epigastrium, for the right hand. The umbilical trocar and the third trocar can be used alternately for the camera or the surgeon's right hand. A fourth 5-mm trocar for the assistant can be placed on demand for the dolichocolon or greater omentum.

- Approach to the inferior vascular pedicle, medial vs. lateral:
Right colectomy can be started by performing a right coloparietal dissection from caudal to cranial to free the colon from the prerenal fascia and then descending the hepatic flexure. The main vascular pedicles (ileocolic, right colic, and right branch of the middle colic arteries) are then treated by monopolar dissection and vascular occlusion with a harmonic scalpel, vascular sealant, or polymer clips. Another way to approach the right colon is to first perform a medial approach to treat the proximal ileocecal arterial pedicle or over the vein, depending on the level of dissection D2 or D3. The dissection is then continued cranially until the right and medial pedicles are found, finding and releasing the preduodenal Fredet fascia from its adherence to the colon, until reaching the hepatic flexure. According to the latest published works on CME with or without D3 and high vascular ligation, the lymphadenectomy to be considered D3 must be performed along the origin of the right colic veins (ileocecal, right colic and middle colic) at their origin in the superior mesenteric vein (SMV), on the right lateral border or on its anterior surface, identifying the homonymous arteries and ligating them at their origin. It is not necessary to ligate the Henle trunk, but it is necessary to ligate the right colic veins at their origin in said trunk up to the root of the mesocolon. Monopolar vascular dissection together with the placement of polymeric clips is optimal at this time. According to the Japanese doctrine the level of lymph node dissection can be classified by the relationship with the SMV. This classification is attached in the corresponding section.

- Identification of the right ureter and duodenum:
Although the release of the right colon does not imply a probable injury to the right ureter because vascular ligatures should not be performed at that level as in the left colon, it is necessary to remember the intimate relationship of the ureter with the posterior aspect of the colon. However, if the interureteral fascia is not injured, the injury to the retroperitoneum probably does not imply injury to the ureter. Another situation in this colectomy, particularly in the medial approach, is the intimate contact of the right mesocolon with the duodenum. The preservation of the duodenal peritoneal window, identified as the mesothelial tissue between the ileocolic pedicle and the middle colic pedicle, is essential to perform a complete and adequate dissection of the mesocolon, together with the lymph node dissection.

- Lymph node count:
Central vascular ligation is key in the oncological resection of right and left colon tumors and is based on the removal of the involved central lymph nodes, which occurs in up to 11% in right colectomy and in 8.6% in left colectomy.[1] There is also the possibility of discontinuous lymph node metastases (*skip metastases*) in 2 to 18% of cases. Furthermore, there is a direct relationship between T and N, since T3 and T4 tumors are associated with central lymph node metastases in up to 8%, while the *skip metastasis* rate is almost zero in T1 and T2 tumors.[2] Resection of this lymph node level would bring an additional oncological

benefit equivalent to resection of liver metastases, due to a decrease in local lymph node recurrence. The importance of lymphadenectomy involves knowing the territory corresponding to each tumor level, since there is a direct correlation between the number of lymph nodes removed and survival. Therefore, until the results of new randomized studies are published, the recommendation would be to perform a wide and adequate D2 dissection, with central vascular ligation and complete dissection of the mesocolon in all cases. D3 dissection would be reserved for groups trained in a research context. Table 11.1 specifies the type of surgery, vascular ligation and lymphadenectomy indicated according to the tumor location.

Table 11.1. Type of surgery, ligation, and lymphadenectomy according to tumor location.

Site of the tumor	Type of surgery	Vascular ligation	Lymphadenectomy*
Cecum	Right colectomy	Ileocolic Right colic: under discussion	Regular 201-202 Trained 203-213
Ascending colon	Right colectomy	Ileocólica + cólica derecha + rama derecha cólica media	201-202, 211-212, 201-222 Central: 203-213-223

*Numbering according to Japanese literature.

- Anastomosis:
Following colectomy and vascular treatment, the terminal ileum and transverse colon are divided with a linear cutting stapler, whether articulated or not. A sutured or stapled anastomosis is then performed, usually in a side-to-side and anisoperistaltic manner. The anastomosis may be reinforced with sutures to ensure its tightness.

- Extraction of the surgical specimen:
The specimen is usually removed through a Pfannenstiel incision. Alternatively, it may be removed through the extended umbilical incision (at the cost of a higher rate of incisional hernia), through a right subcostal incision, or through the vagina. Wound closure, drain placement, and postoperative care are similar to those for laparoscopic left colectomy.

LEFT COLECTOMY

Left colectomy is the most common surgical procedure in colorectal pathology, so it is essential to have adequate training, both in laparoscopy and in colorectal pathology, to perform a safe surgery.

In the early days of laparoscopic colorectal surgery, it was considered that left colectomy should be the first surgery to be performed after formal training in simulators. However, it is a procedure that has a potential risk of injuring organs or structures that can cause immediate major complications, or anatomical or functional sequelae.

This procedure is feasible to be regulated and has perfectly established steps. It is noted that laparoscopic colectomy does not only involve the technical procedure of removing a segment of the colon, but the treatment begins several days before with aspects related to diet, bowel preparation and general preparation of the patient, since all of this improves surgical results

- Trocars. Arrangement and variations:
The establishment of pneumoperitoneum and initial exploration of the abdominal cavity are identical to those performed in right colectomy. For left colectomy, it is usual to place 4 trocars, two of 10-12 mm in the umbilical region (camera and grasper for left hand) and the right upper quadrant (camera) and one of 10-12-mm or 12-15-mm (right hand and placement of the linear articulated cutting stapler). In the presence of large and lipomatous mesentery, exuberant epiploic appendices, dolichocolon or redundant omentum, the placement of a 5-mm trocar in the left flank for an assistant's traction forceps is suggested, although it is possible to complete the surgery without this trocar, as has occurred in our experience with selected cases performed with only 3 trocars and without an assistant. In case of technical difficulty, it is possible to add a fifth 5-mm trocar, either in the hypogastrium (to eventually migrate to a larger trocar to perform the bowel section), or in the epigastrium (to mobilize the splenic flexure). It is possible to perform the operation with disposable or metal trocars (consider capacitance in the metal ones). The pneumoperitoneum is usually with medium-high flow (20 to 30 liters of CO_2) with a pressure of 10 to 12 mm Hg.
Other surgical schools use a 10-mm umbilical trocar for the camera, a 5-mm trocar in the left upper quadrant for the surgeon's left hand and a 10-12-mm trocar in the right lower quadrant for the right hand, adding a fourth 5-mm trocar in the left flank or left upper quadrant.

Tip – The placement of 5-mm trocars does not alter the postoperative course, so it is suggested that the surgery be performed in the most comfortable way possible.

- Approach to the inferior vascular pedicle, medial vs. lateral
One of the main steps of this surgery is the approach to the inferior mesenteric vascular pedicle, which can be either lateral or medial. The lateral approach, recently prioritized, is similar to the historical lateral approach performed in a conventional colectomy, with the left coloparietal detachment expanding all the elements of the retroperitoneum and separating the mesocolon from the left Toldt fascia to the prerenal Gerota fascia and splenic flexure. On the other hand, the medial approach, which was primarily described in laparoscopy of the left colon, is performed by creating a triangular window formed by the mesenteric artery on the left, the mesorectum above and the retroperitoneum below. At the base, the left ureter is identified and progress is made laterally to complete the dissection of the mesocolon. The choice of each approach depends on the surgeon, although they can be combined in a complex case.

Tip – Both medial and lateral approaches are useful. They should be adapted to the case. Do not hesitate to alternate the approach if the one initially chosen is difficult.

- Identification of the left ureter
The left ureter is one of the most important elements of the retroperitoneum in left colon surgery. It must be identified before ligating the inferior mesenteric vascular bundle in oncological cases and also before performing more distal ligatures (left colic, etc.). In complex cases, tutoring of the ureter with a conventional catheter or with transillumination should be considered. Although the ureter can be injured along its entire length, identification is essential in 3 places: 1) when it runs lateral to the inferior mesenteric artery in a triangle formed by the aorta downwards, the inferior mesenteric to the left and the mesocolon or mesorectum to the right, 2) when it makes contact with the iliac artery on its entry into the lesser pelvis and 3) when it leaves the pelvis and runs on its lateral wall to find the bladder, particularly in TME surgery.

Tip 1 – If the iliac vessels are identified, the dissection is in a deeper plane than intended and the ureter may be injured.

Tip 2 – Do not forget that the ureter can be injured in 3 places and not only during artery dissection.

- High or low vascular ligation
Ligation of the inferior mesenteric artery is performed after identification of the left ureter. Placement of polymer or metal clips and sectioning with a sealant-type energy platform or harmonic scalpel is suggested. In a complete left colectomy, the artery should be sectioned close to its origin in the aorta, traditionally 1 cm above it to avoid injury to the autonomic nerves that will form the hypogastric plexuses. However, in ideal situations this nerve can be identified and isolated, allowing arterial section as close to its origin as possible. In a sigmoid resection, it is possible to ligate the sigmoid artery trunk and spare the left colic artery.

Tip – Do not ligate the mesenteric artery less than 10-mm from its origin in the aorta because vascular control will be very difficult.

- Ligation of the mesenteric vein
Once the patient is in the Trendelenburg position and rotated to the right, the entire small intestine is deployed upward and to the right, taking care not to injure it. This should be done without pressure and with maneuvers directed toward the mesentery. The inferior mesenteric vein (IMV) is located at the lower border of the transverse mesocolon, below the angle of Treitz. This is initially ligated and divided, especially in complete left colectomies (it may be omitted in sigmoidectomies). By dissecting to the right of the vein, it is possible to begin mobilization of the splenic flexure by a medial approach (see below).

Tip 1 – For sealing and sectioning any vascular element, particularly a vein, always reduce traction to allow for proper sealing. It is also suggested to place distal and proximal clips to ensure hemostasis, although this is debatable.

Tip 2 – To avoid sealing failure, use sealing forceps of the appropriate size for the size of the vessel being treated.

Tip 3 – Sometimes the vein runs alongside the ascending branch of the left colic artery, a configuration known as the vascular arch of Treitz.

- Mobilization of the splenic flexure - how and when?
It can be performed systematically or selectively depending on the service. If it is performed systematically, it is suggested to do so at first, after sectioning the IMV. After this section, one option is to complete the mobilization of the splenic flexure by a medial approach.
When the splenic flexure is mobilized, the colectomy is considered as a left upper colectomy, similar in all steps to the left lower colectomy or sigmoid colectomy. Left upper colectomy, which involves segmental resection with colo-colic anastomosis, is performed for tumors of the splenic flexure or proximal descending colon.
There are three types of mobilization of the splenic flexure by laparoscopic means, which can even be reproduced by conventional means. They are named according to the anatomical route used to access the epiplonic cavity: 1) anterior approach, between the transverse colon and the greater omentum, through the embryological layer, 2) lateral approach, through the lateral edge of the greater omentum and the splenocolic ligament and 3) medial approach, between the transverse colon and the pancreas, approaching the retroperitoneum. These approaches can be combined, taking parts of each one. Other authors consider two types of approach: the anterior approach itself, with division of the gastrocolic ligament and the anterior transepiploic approach, with division of the greater omentum. There are two accessory medial approaches, one inframesocolic, which accesses the lesser sac through the lower edge of the pancreas without opening the transverse mesocolon, and another transmesocolonic, in which the transverse mesocolon is directly sectioned to the left of the middle colic vessels. Angular mobilization consists of sectioning the splenocolic, phrenocolic, gastrocolic and finally pancreatocolic ligaments. The IMV is ligated at its origin at the lower border of the pancreas, a maneuver that involves a mobilization of 10 to 12 cm.
- **Lateral approach:** the descending colon is mobilized on its lateral side, separating it from Gerota's fascia up to the splenic flexure, a lateral release of its adhesions to the spleen is performed, and then the lesser sac is accessed near the tail of the pancreas. The greater omentum is separated from the transverse colon. This approach presents a higher risk of bleeding and increases operating time, so it should not be the first option.
- **Medial approach:** the IMV is accessed by separating the descending colon from Gerota's fascia towards the cranial side. Near the anterior border of the pancreas, the lesser sac is accessed and the medial mobilization is completed. The vein at the inferior border of the pancreas is divided and the greater omentum is separated from the transverse colon towards the lateral side. This approach is associated with greater difficulty in obese patients and those with a history of pancreatitis. Ten percent of patients have an accessory artery (Moskowitz artery) that joins the middle colic artery with the left colic artery, which makes dissection difficult and increases the risk of bleeding.
- **Anterior approach:** the lesser sac is entered between the greater omentum cranially and the transverse colon caudally, continuing the dissection towards the left lateral border until the splenic flexure and the descending colon are mobilized.

Tip 1 – For the descent of the splenic flexure, after ligation of the IMV, it is recommended to continue along this plane towards the cranial plane, preserving the lower edge of the pancreas, with the colon above and the retroperitoneum below the dissection plane. Then, along the lower edge of the coloepiploic plane, approach the lesser sac towards the left up to the lateral wall, and from there, complete the mobilization. In this way, it will generally not even be necessary to visualize or dissect the spleen.

Tip 2 – Both the medial and lateral routes can be complex approaches in obese patients or those with difficulty identifying embryological planes.

- Division of the mesorectum and distal rectum
After identifying the elements of the retroperitoneum and performing the vascular division, the mesorectum is dissected. In left colectomies, it is limited to a partial dissection, generally with the rectum divided at the rectosigmoid junction, at the level of the sacral promontory or below it. For the division of the mesorectum, it is suggested to use an energy platform (vascular sealant, harmonic scalpel) to avoid bleeding. It is important to release the rectum circumferentially to avoid its fixation and possible difficulties or complications at the time of the circular stapled anastomosis. The rectal transection is performed with a straight or articulated linear cutting stapler depending on the height. In general, 1 to 2 stapler fires are necessary. The use of a curved cutting stapler is not usually indispensable, it is generally reserved for low rectal resections.

Tip – Free the rectum with adequate circumferential dissection. This prevents tractions that may cause tears or bleeding during placement of the circular stapler.

- Extraction of the surgical specimen
The extraction of the specimen can be done through an oblique incision on the left side, a median incision (extension of the umbilical port) or the Pfannenstiel incision. Each has its advantages and disadvantages and are indicated by the surgeon on an individual basis. If possible, a hermetic wound protector is placed to be able to reconstruct the pneumoperitoneum.

After extracting the specimen, the anvil of the circular stapled is placed, the colon is reintroduced and the pneumoperitoneum is restored, closing the wound or the wound protector.
In the case of performing an intracorporeal anastomosis, it is suggested to remove the specimen with a bag through the suggested incisions or natural orifices.

- Anastomosis, rectal lavage and air leak test
Colorectal anastomosis for left colectomy is performed end-to-end with a circular stapler. After the anastomosis and before performing the leak test, it is advisable to place a proximal clamp to perform a washout with cytotoxic iodine solution or a profuse transanastomotic saline washout. After completing the distal rectal lavage, the tightness of the anastomosis and the possible presence of subclinical bleeding foci are checked with a probe, rigid proctoscope or flexible endoscope.

- Fluorescein
As described in the corresponding chapter on fluorescein-guided surgery, its use has recently been introduced for perfusion control and identification of the appropriate site for proximal division of the colon after vascular ligation. This step is performed immediately before bowel transection. Recent evidence indicates that its application significantly decreases the rate of anastomotic dehiscence. This technology can also be used endoscopically for control of colorectal anastomosis.

- Closure of the mesocolon defect
The closure of the mesocolon resection defect can be performed with absorbable sutures. However, it has not been proven that this is necessary for left colectomies.

- Drains and wound closure
According to ERAS guidelines, there is no need to place drains in left colectomies. Their placement could be considered depending on the associated pathology, collections, peritonitis or high risk of dehiscence. Closure of 5-mm trocar wound is only necessary on the skin. In the case of trocars ≥ 10-mm, it is recommended to close the fascial plane with Endoclose® or similar. The wound closure at the specimen extraction site is done in layers, after washing with cytotoxic solutions.

Tip – Do not routinely drain. Always close the fascia of trocar sites ≥ 10-mm.

- Need for protective ostomy
Protection of the anastomosis with a transverse colostomy or loop ileostomy is recommended in the presence of:
• Patient with high surgical risk: comorbidities, sepsis, intraoperative cardiovascular events, poor general condition, etc.
• Underlying pathology: associated diffuse purulent peritonitis, fecal peritonitis, intestinal ischemia
• Anastomosis with positive air leak test, mechanical failure of the stapling device, doubt about possible ischemia of the intestinal ends.

SPLENIC FLEXURE TUMORS

Eight percent of colon tumors are located in the splenic flexure. They are generally associated with a worse prognosis because the diagnosis is usually made in advanced stages with lymphatic invasion and sometimes with colonic obstruction. Anatomically, this flexure is located in a more cranial and posterior position, and is more acute than the hepatic flexure. It is related posteriorly to the lower pole of the left kidney and anteriorly to the greater curvature of the stomach. It is attached to the diaphragm, the lateral wall of the abdomen, the lower pole of the spleen and the tail of the pancreas by the phrenic-colic ligament. Blood supply is highly variable, normally depending on the left colic artery, although in up to 10% of cases it depends on the left branch of the middle colic artery. Since the middle colic artery is absent in up to 20% of cases, an accessory middle colic artery has been described that arises from the superior mesenteric artery. Due to the great variability of vascular anatomy associated with a great variation in the arrangement of lymph nodes, there is no standardized surgical approach for the splenic flexure. For some authors, lymph node dissection should include the left branch of the middle colic artery and the root of the IMV. In tumors located in the proximal part of the descending colon, the dissection should be performed at the level of the left colic artery and at the root of the IMV. In tumors located in the flexure itself, it is necessary to ligate the middle and left colic arteries.

Four types of resections have been described:
● **Extended right hemicolectomy:** resection of the right colon, transverse colon, and part of the descending colon, ligating the right, middle, and left colic vessels, with an ileocolic anastomosis.
● **Extended left hemicolectomy:** resection of the left third of the transverse colon up to the rectosigmoid junction, ligating the inferior mesenteric vessels and the left branch of the middle colic artery.
● **Segmental resection:** trasection of the distal portion of the transverse colon and the first part of the descending colon, ligating the left branch of the middle colic vessels, the left colic vessels, and the IMV.
● **Extended resection:** indicated for large, locally advanced tumors with regional lymph node metastasis, vascular involvement, dilation of the proximal colon, or involvement of adjacent organs where en bloc resection is indicated.

The type of resection of splenic flexure tumors remains a matter of debate and is currently the subject of study.[3] Controversial issues include the type of lymphadenectomy necessary to obtain the largest lymph node harvest and the site of lymphatic drainage of the tumor. The evidence accumulated to date does not report significant differences in terms of oncological quality and short-term results between segmental resections and extended resections.[4]

- Splenic flexure mobilization
Mobilization of the splenic flexure is essential both to address tumors in that location and to ensure complete release of the left colon to achieve a tension-free and well-vascularized anastomosis. There is no consensus on whether it should be performed systematically or selectively, and this varies according to each group. It is considered a challenging moment in the surgical technique since it increases operating time, is associated with the possibility of injury to adjacent organs, and is generally the main cause of intraoperative bleeding. The technique for splenic flexure mobilization has been previously described.

TUMORS OF THE TRANSVERSE COLON

For tumors of the transverse colon, segmental colectomy with proximal and distal safety margins plus lymphadenectomy corresponding to the nutrient artery close to the tumor site is accepted. The great variability of vascular anatomy at this level makes the type of vascular ligation very irregular. If the greater omentum is involved or firmly adhered to the tumor, en bloc omentectomy is recommended.

In a tumor of the proximal and middle transverse colon, the indication is a segmental transverse colectomy, or an extended right colectomy, according to the surgeon's preference. This includes resection of the lymphovascular pedicle corresponding to the left branch of the middle colic vessels.

In cancer of the distal transverse colon proximal to the splenic flexure, irrigation and lymphatic drainage correspond to the left branch of the middle colic and distally to the left colic vessels. The middle colic vessels are usually ligated to allow anastomosis between the proximal part of the transverse colon and the proximal sigmoid colon. Malignant tumors arising from the middle transverse colon

can be removed by transverse colectomy. Dissection is initiated by opening the lesser sac, dividing the gastrocolic ligament below the gastroepiploic arcade. In case of tension in the anastomosis, the hepatic and splenic flexures are subsequently released. This maneuver can be avoided if there is a garland colon. Finally, the lymphovascular areas of the middle colic vessels are removed, leaving the colon close to the hepatic flexure as the proximal end with blood supply provided by the terminal branches of the right colic artery. Distally, the ascending branch of the left colic artery is included. Bowel transit is preferably restored with an end-to-end anastomosis.

SUBTOTAL COLECTOMY

The approach may be minimally invasive or conventional through a midline supra- and infraumbilical incision. In the conventional approach, colonic dissection begins in the cecum. After mobilization of the colon and its splenic and hepatic flexures, vascular ligations are performed.

In the laparoscopic approach, the patient is placed in the Lloyd-Davis position (modified lithotomy) with limb protectors. Five to six trocars (usually four 10-mm and one or two 5-mm) are placed in the four abdominal quadrants. Vascular control is performed using Ligasure® (Ligasure Atlas; Valleylab, Boulder, CO), or a Harmonic Shears (Ethicon, Cincinnati, OH).

The approach went through different stages until it was determined that the shortest operating time is achieved by first ligating the vascular pedicles and then releasing all segments of the colon. Whether the dissection begins from proximal to distal or in the reverse direction varies according to the preference of different surgeons.

The omentum can be separated from the transverse colon and left as a dependency of the greater curvature of the stomach. However, it is usually more effective to divide the gastrocolic ligament and remove the omentum along with the colon. In synchronous tumors, colonic resection is performed according to oncologic principles.

If it is decided not to perform an anastomosis, the terminal ileum is exteriorized as a Brooke ileostomy in the right iliac fossa and the rectosigmoid colon can be treated in several ways:

- Exteriorization as a suprapubic mucous fistula at the lower edge of the incision (benign emergency pathology)
- Closure of the sigmoid stump, leaving it supraaponeurotic and subdermal.
- Closure of the upper rectum, leaving it in the abdominal cavity (Hartmann operation).

These last two options avoid the continuous discharge of mucus and blood that occurs with a mucous fistula. Their main drawback is the risk of dehiscence, which is of course extremely serious if the colon has been left closed in the cavity, whereas this is not the case if it is placed subdermally. In this case, if a dehiscence of the stump occurs, it is sufficient to open the skin, whereas if it remains closed in the peritoneal cavity, an emergency laparotomy is necessary. In the other cases, intestinal continuity is restored by handsewn or stapled end-to-end or side-to-end ileorectal anastomosis.

In laparoscopy, the distal end is first divided intracorporeally using a laparoscopic stapler (EndoGIA®; US Surgical, Norwalk, CT). To perform the proximal intestinal transection, a small incision is made in the right lower abdominal quadrant over the 10-mm trocar site, and the terminal ileum is divided using a linear stapler (GIA®; Ethicon, Cincinnati, OH). The anvil of the circular stapler (EEA Stapler®; Ethicon, Cincinnati, OH) is then introduced into the proximal end to be anastomosed and secured with a nonabsorbable purstring (Prolene®; Ethicon, Cincinnati, OH). An end-to-end, or better yet, side-to-end, ileorectal anastomosis is then performed.

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