



Robotic Splenic Flexure and Segmental Transverse Resections

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8.1 Background

The most important randomized controlled trials [1–3] that demonstrated the oncological adequacy of laparoscopic surgery for colon cancer resection did not include cancers located at the level of the splenic flexure (SF) and the transverse colon (TC). Indeed, segmental resections of SF and TC can be technically challenging with concerns for an appropriate oncologic outcome. Lymph node dissection, vascular dissection and intracorporeal anastomosis are considered the most demanding steps during segmental resections for TC and SF cancers [4].

The evidence currently available in the literature shows that the minimally invasive approach for segmental resections of SF and TC cancer has equivalent oncological outcomes and better short-term outcomes compared to conventional open surgery [5, 6]. Furthermore, a growing interest in the application of the robotic approach for these segmental resections was shown in the last year [5–8]. Compared to conventional laparoscopic colectomy, the robotic approach for segmental resections seems to have a higher rate of intracorporeal anastomosis, a longer mean operative time and a higher mean number of harvested lymph nodes [8].

In this chapter we describe our full-robotic standardized technique for SF and TC resection, using the da Vinci Xi robot (Intuitive Surgical Inc., Sunnyvale, CA).

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8.2 Robotic Instrumentation

Recommended main equipment:

- 30° endoscope
- fenestrated bipolar forceps
- monopolar scissors
- large needle driver
- vessel sealer (optional)
- tip-up grasper.

8.3 Splenic Flexure Resection

8.3.1 Patient Positioning, Trocar Layout and Operating Room Setup

The patient is placed in a lithotomy position with arms alongside the body. Pneumoperitoneum is established via a Veress needle inserted in the left hypochondrium at Palmer's point. Access to the abdominal cavity is gained with a 12-mm assistant port in the right flank. Access to the abdominal cavity is gained with a 12-mm assistant port in the right flank.

Then a laparoscopic exploration is performed to correctly identify the level of the lesion before deploying the trocars and docking the robot. Four 8-mm robotic trocars are then placed along an oblique line, starting from the right subcostal to the suprapubic region, which may vary according to the confirmation of the abdomen, as well as to intra-abdominal anatomy. Trocar layout is shown in Fig. 8.1. With this

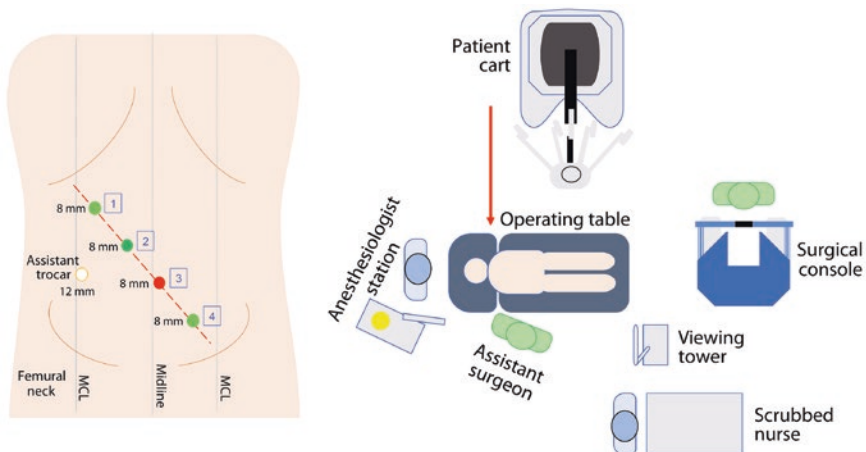


Fig. 8.1 Splenic flexure resection. Trocar layout (*left*): (1) tip-up grasper; (2) bipolar forceps; (3) camera 30° down; (4) monopolar scissors/robotic stapler. Operating room setup (*right*)

trocar placement, the surgical workspace (the space that must be reached by the instrument tips to perform the procedure) extends from the middle colonic vessels to the inferior mesenteric artery (IMA).

A limited lysis of adhesions, when present, is performed laparoscopically just to enable robotic trocar positioning under direct vision; adhesions are then taken down under robotic assistance.

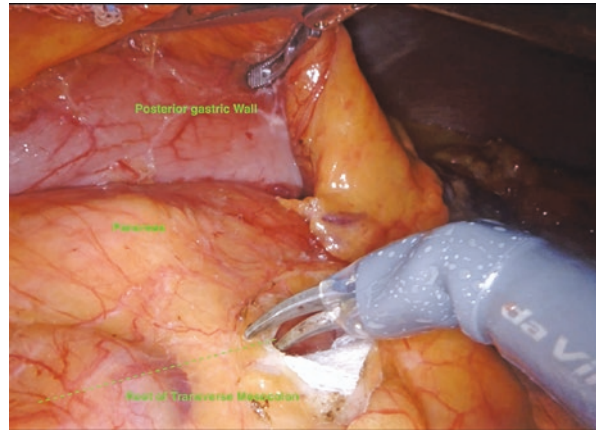
The patient is then placed in a right tilt (10–15°) and in Trendelenburg position in order to achieve exposure of the operative field. During the procedure, the position can be modified according to the step of the operation. The small bowel is placed in the right abdominal quadrants: the TC and omentum are pulled up in the upper quadrants, the ligament of Treitz and the origin of the inferior mesenteric vein (IMV) are exposed.

The robotic cart is docked from the patient's left side and a da Vinci Xi system (Intuitive Surgical, Sunnyvale, CA, USA) is used. A full-robotic single-targeting procedure is performed. The assistant surgeon and the scrub nurse stand on the patient's right side (Fig. 8.1). The tip-up grasper, bipolar forceps and monopolar scissors/vessel sealer are mounted on robotic arm 1 (R1), arm 2 (R2), and arm 4 (R4), respectively. Robotic arm 3 (R3) is used for the 30°-down scope. Targeting is performed at the level of the SF.

8.3.2 Surgical Technique

For SF resection we start with a supramesocolic approach. The gastrocolic ligament is divided and the lesser sac opened. The gastrocolic ligament is lifted up with tip-up grasper (R1): the assistant retracts the TC from one epiploic appendage. The lesser sac is opened using fenestrated bipolar forceps (R2) and monopolar scissors (R4). The tip-up grasper (R1) is introduced in the lesser sac for omentum/posterior gastric wall traction, the transverse mesocolon is delivered from any attachment with the lesser sac, and TC is fully mobilized in a medial-to-lateral fashion. During this step the vessel sealer (R4), can be helpful to accelerate the dissection. Especially in locally advanced cancer and young patients, we remove the greater omentum in correspondence of SF and perform a lymph node sampling at the level of the left gastroepiploic vessels. Then the tip-up grasper (R1) lifts up the TC and the duodenal-jejunal angle is mobilized to achieve complete exposure of the origin of the IMV. This is dissected at its origin and divided between self-locking clips at the inferior border of the pancreas. The assistant maintains the jejunal loops in the right quadrants. The IMV is lifted up with the fenestrated bipolar forceps (R2) and the peritoneum under the IMV is incised. The dissection continues along the Toldt's planes, in a medial-to-lateral fashion as lateral as possible. The dissection continues downward to the origin of the IMA, where a lymph node sampling is carried out. Then the left colonic artery (LCA) is isolated and divided between self-locking clips. After that, mobilization of the left mesocolon and the SF is completed, with a

Fig. 8.2 Dissection of the root of the transverse mesocolon from the pancreatic body



lateral-to-medial dissection. The splenicocolic and the phrenicocolic ligament are detached, gaining the previously delivered plane.

The root of mesocolon is incised from the pancreatic tail and the pancreatic body in a lateral-to-medial fashion (Fig. 8.2). The middle colonic vessels are identified and a lymph node sampling is performed. Then the left branches of the middle colic vessels are divided.

The transverse mesocolon is divided and the colon is sectioned with a 60-mm laparoscopic stapler, after bowel perfusion assessment with the indocyanine-green fluorescence imaging system. The reconstruction is performed with a robotic hand-sewn end-to-end colocolonic anastomosis (see Video 8.1).

The large needle driver is mounted on R4. To achieve a better exposure, a stay suture is placed on the proximal and distal colonic stump and lifted up by the tip-up grasper (R1). The anastomosis starts with approximation of the proximal and distal colonic stumps using a posterior wall interrupted absorbable suture. Then the two stapler lines are removed with monopolar scissors (R4). Starting from both corners, the posterior and anterior walls are closed using an absorbable barbed running suture. The colocolonic anastomosis is reinforced with seroserosal absorbable interrupted stitches and an omental flap.

The robot is undocked and, with the aid of an abdominal wall protection device, the specimen is usually retrieved through a suprapubic Pfannenstiel incision.

8.4 Transverse Colon Resection

8.4.1 Patient Positioning, Trocar Layout and Operating Room Setup

The patient is placed in a supine position with arms alongside the body and legs closed. Pneumoperitoneum is established via a Veress needle inserted in the left

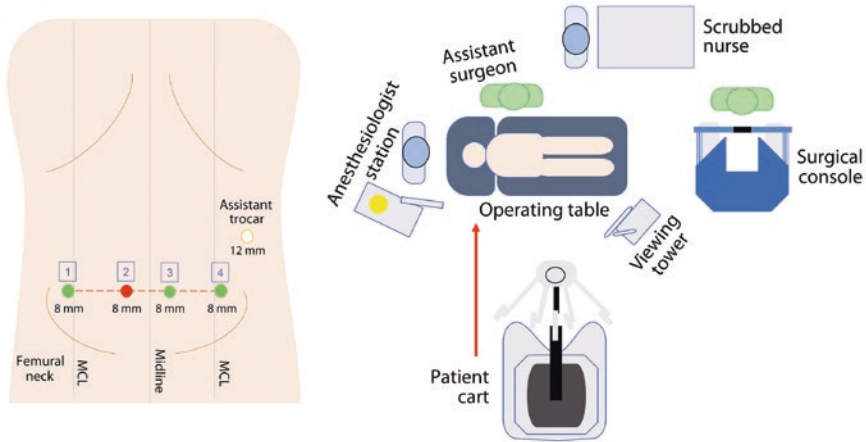


Fig. 8.3 Transverse colon resection. Trocar layout (*left*): (1) bipolar forceps; (2) camera 30° down; (3) monopolar scissors/robotic stapler; (4), tip-up grasper. Operating room setup (*right*)

hypochondrium at Palmer's point. Access to the abdominal cavity is gained with a 12-mm assistant port in the left flank.

Then a laparoscopic exploration is performed to correctly identify the level of the lesion and TC anatomy before placing the trocars and docking the robot. Four 8-mm robotic trocars are then inserted along a transverse suprapubic line about 4 to 5 cm above the pubis. Trocar layout is shown in Fig. 8.3.

With this trocar placement the surgical workspace (the space that must be reached by the instruments tips to perform the procedure) extends from the right to the left colon

The patient is then placed in a reverse Trendelenburg position (10–15°) in order to achieve exposure of the operative field.

The robot cart is docked from the patient's right side (Fig. 8.3). The da Vinci Xi system (Intuitive Surgical, Sunnyvale, CA, USA) is used. A full-robotic single-targeting procedure is performed. The assistant surgeon and the scrub nurse stand on the patient's left side.

Bipolar forceps, monopolar scissors/vessel sealer and tip-up grasper are mounted on robotic arm 1 (R1), arm 3 (R3) and arm 4 (R4), respectively. Robotic arm 2 (R2) is used for the 30°-down scope. Targeting is performed at the center of TC.

8.4.2 Surgical Technique

Also for segmental resection of TC we start with a supramesocolic approach. The gastrocolic ligament is sectioned and the lesser sac opened. The gastrocolic ligament is lifted up with a tip-up grasper (R4): the assistant retracts the TC from one epiploic appendage. The lesser sac is opened using fenestrated bipolar forceps (R1) and monopolar scissors (R3): the gastrocolic ligament is fully detached from the

TC, in a medial-to-lateral fashion, up to the SF. During this step the tip-up grasper (R4) is introduced in the lesser sac for omentum/posterior gastric wall traction, and the transverse mesocolon and posterior gastric wall are freed from any attachment with the lesser sac. During this step the vessel sealer (R3) can be helpful to accelerate the dissection, especially in the obese patients. In cases of complex dissection at the level of the gastrocolic ligament, with the impossibility to enter the lesser sac, we suggest dividing the coloepiploic ligament.

Then, in a lateral-to-medial fashion, the SF is fully mobilized: the splenicocolic and phrenicocolic ligaments are detached. According to the localization of the tumor and the length of TC, the proximal part of the descending colon can be mobilized along the Toldd's plane. A gauze is lifted under the transverse mesocolon. At this point the root of the mesocolon is incised from the pancreatic tail and the pancreatic body in a lateral-to-medial fashion (Fig. 8.2). During this step the tip-up grasper (R4) retracts the posterior gastric wall, the assistant retracts the TC from one epiploic appendage toward the right iliac fossa, and the dissection is carried out with fenestrated bipolar forceps (R1) and monopolar scissors/vessel sealer (R3).

Then dissection continues toward the right side opening the lesser sac and separating the transverse mesocolon from the pancreas at the level of Fredet's plane and the anterior wall of duodenum.

The origin of the middle colic vessels, under the inferior pancreatic border, Henle's trunk and the right gastroepiploic vessels are identified. Depending on the case, the dissection can be performed via the supra- or inframesocolic space.

The middle colic vessels are divided. A lymph node sampling at the level of right gastroepiploic vessels is carried out. Then the right colonic flexure is mobilized.

The transverse mesocolon is divided and the colon is sectioned with a 60-mm laparoscopic stapler, after bowel perfusion assessment with the indocyanine green fluorescence imaging system. Reconstruction is performed with a robotic hand-sewn end-to-end colocolonic anastomosis, as described for reconstruction of the SF resection (see Video 8.1).

The robot is undocked and, with the aid of an abdominal wall protection device, the specimen is usually retrieved through a small suprapubic incision performed by conjoining the two paramedian 8-mm suprapubic port sites.

8.5 Conclusions

The minimally invasive approach for segmental resection of TC and SF cancers has comparable oncological outcomes to conventional open surgery [5]. The laparoscopic approach is considered technically demanding for these colorectal resections, mainly for vascular resection, lymph node dissection and intracorporeal anastomosis [4]. The robotic approach for these segmental resections, thanks to its intrinsic technological features, seems to increase the lymph node harvest, reducing the conversion rate and favoring the intracorporeal anastomosis [6–9].

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