Laparoscopic Right Colectomy

Caleb Van Essen, Lydia Kersh, Maya Roytman, Richard Davis

Introduction:

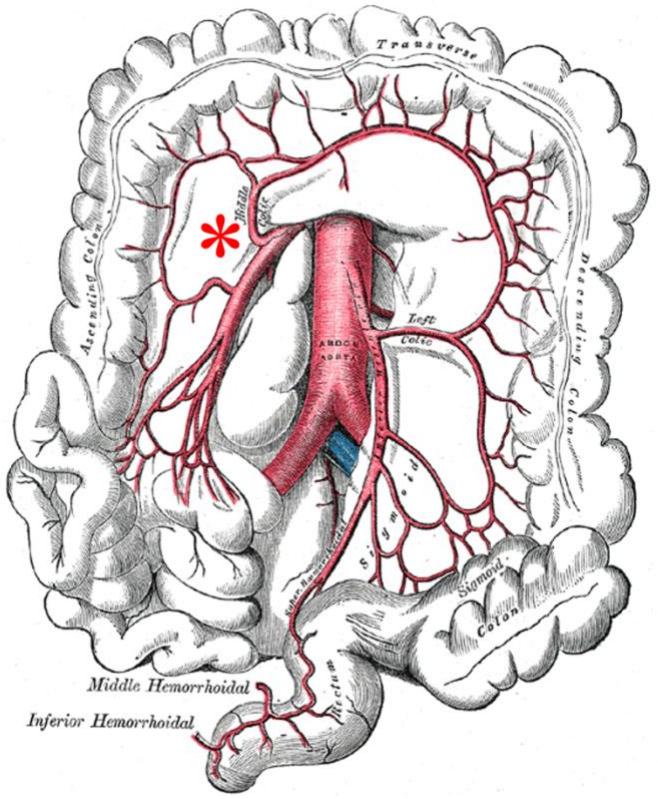
Editor's note: There are many techniques for laparoscopic colon surgery described in the literature. Most require energy devices and endoscopic staplers. We present here a simple technique of right hemicolectomy that can be performed with a 10mm scope, diathermy, and allows for extracorporeal hand-sewn anastomosis.

Right hemicolectomy can be an elegant operation and is performed for various etiologies in both the elective and emergent setting. Neoplasia makes up the majority of the indications for right hemicolectomies. These patients often present with obstruction, bleeding, or neoplastic findings on colonoscopy. Additional etiologies include: cecal volvulus, strictures, obstruction, unresectable polyp, fistula, and appendiceal cancer. In this chapter we will be speaking primarily about elective surgery for neoplasia however these principles can be applied to most scenarios.

Preoperatively it is important to make sure every patient with known cancer diagnosis gets appropriately staged. CT imaging of the chest, abdomen and pelvis is the primary modality for identifying metastatic disease. Laboratory evaluation is essential with CBC, liver function testing, nutritional assessment and carcinoembryonic antigen level. A complete colonoscopy is needed as additional lesions may be found and thus change the extent of colon resected. This is also helpful to mark the lesion distally, with tattoo ink, as smaller lesions may not be palpable or visualized intraabdominally.

Historically there have been variations in the trends of using a combination of mechanical bowel prep, enteral antibiotics and parenteral antibiotics. Currently we advocate for mechanical bowel prep, enteral antibiotics and preoperative parenteral antibiotics within an hour of incision time (adequate coverage for colonic flora). Having an evacuated colon can be quite helpful with laparoscopic colon surgery improving manipulation of tissue and performing an anastomosis without gross spillage of stool.

A thorough understanding of the anatomy, particularly the vascular supply to the colon and the surrounding organs, is essential in performing this operation, avoiding inadvertent injury and having low complication rate. As shown below, the colon is supplied by both the superior and inferior mesenteric arteries, with arcades connecting the two. The right colon is primarily supplied by the ileocolic and right branches of the middle colic vessels (arterial and venous). Appropriate oncologic resection will include the ileocolic vessel and its associated mesenteric lymph nodes, ideally a minimum of 12 lymph nodes. The proximal superior mesenteric artery and vein, supplying the small intestine, are at risk during lymph node harvest, especially where they run behind the right transverse colon.



The colon is supplied by branches originating from the superior and inferior mesenteric arteries with a rich collateral supply as shown here. During mesenteric lymph node dissection in the region shown by the Red star, injury to the superior mesenteric artery or vein can have disastrous results, potentially leading to ischemia and necrosis of the small intestine.

After the right colectomy is complete, the anastomosis will be supplied by the middle colic and ileal branches of the superior mesenteric artery.

Laparoscopic right colon resection should not be contemplated in patients with hemodynamic instability, cardiac function that would be worsened by raised intra-abdominal pressure, bulky or potentially adherent tumors, or obesity.

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Port placement is as described in Principles of Laparoscopy- Trocar Positioning and Port Placement. Variations of the patient positioning for this operation are discussed in Supine Position. If you have a deflatable bean bag, it is useful to prevent the patient from sliding, otherwise make sure they are secured well.

Laparoscopic right colon resection proceeds in the following steps:

- Laparoscopic access
- Dissection of the retroperitoneal space behind the right colon's mesentery
- Division of the right hepatocolic peritoneal attachments
- Division of the right paracolic gutter peritoneal attachments
- Enlargement of the supraumbilical port site incision
- Delivery of the mobilized right colon out of the peritoneum
- Division of the small intestine, mesentery, and transverse colon
- Extracorporeal (hand-sewn) anastomosis and return of the externalized bowel into the peritoneum
- Closure of the abdomen.

Steps:

1. Ideally use an operating table that can be tilted head up and down and rotated to the patient's left and right. Make sure the controls are accessible to the anesthetist so they can make changes during surgery, as described in the steps below.
2. After induction of general anesthesia, tuck the patient's left arm at their side. Make sure the patient is well secured so there is no chance they will slide off the bed during position changes. Prepare and drape the abdomen widely.

Extremes of head-upwards and head-downwards position will help retract omentum and small intestine away from the cecum during this operation. You must make sure the patient is well secured to the bed before draping them, as you will not be able to tell if they are in danger of sliding off the bed once their body is covered. Note the use of shoulder holders here. Source: Jmarchn, CC BY-SA 3.0 via Wikimedia Commons

3. Make an open entry into the abdomen with a vertical supraumbilical incision and place a Hasson cannula. The incision is vertical because it will later be extended vertically to allow extraction of the colon and extracorporeal anastomosis. (Alternate incisions are described in "Pitfalls" below.)
4. The scope will remain in this Hasson 10mm port for the whole operation. The remaining ports will be 5mm, four more of them are placed as shown below. If you have a 5mm scope, you may insert it into any of the ports as the operation proceeds.

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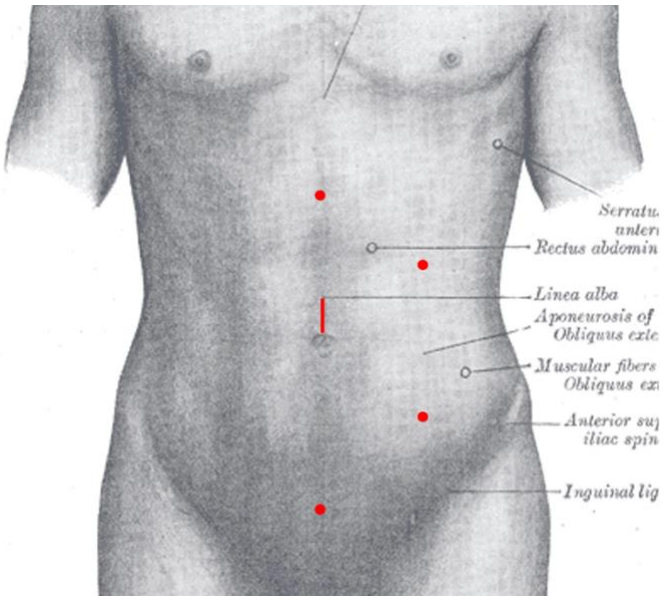
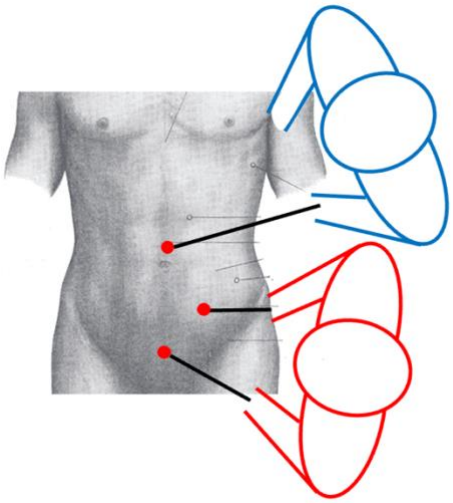


Port positioning: The vertical incision is for a 10mm Hasson cannula. The remaining sites are for 5mm ports. The epigastric port should be placed in such a way that its instruments can avoid the falciform ligament. The surgeon will variably use the upper or lower two ports, standing to the right or left of the camera operator, as described further below.

5. Tilt the bed head-downwards (Trendelenburg's position) and rotate the left side down. Lift the omentum cephalad to expose the colon, mesentery and small bowel. Sweep the small bowel to the patient's left. You can use additional maneuvers such as bed positioning, additional assistant port, or placement of gauze retraction pad.
6. For steps #7-9 (the part of the operation that is in the lower abdomen) the surgeon will stand to the camera operator's left and use the two lower 5mm ports. The camera operator may pass a grasper through one of the upper ports to assist in retracting small bowel or omentum if necessary.



For all of the operation, the camera remains in the supraumbiolical port, operated by the Blue surgeon. For the first part of the operation, the Red (operating) surgeon stands to the camera operator's left and operates through the left lower quadrant and supraumbilical ports.

The surgeon (Red dot) stands to the left of the camera operator (Blue dot.) Note that the camera operator's other hand can assist with retraction (Blue arrow.)

7. To identify the ileocolic vascular pedicle, grasp the ileum at the ileocecal valve, shown by an antimesenteric fat pad, and retract anteriorly, towards the patient's abdominal wall. The vascular pedicle, on tension after this maneuver, can be seen.

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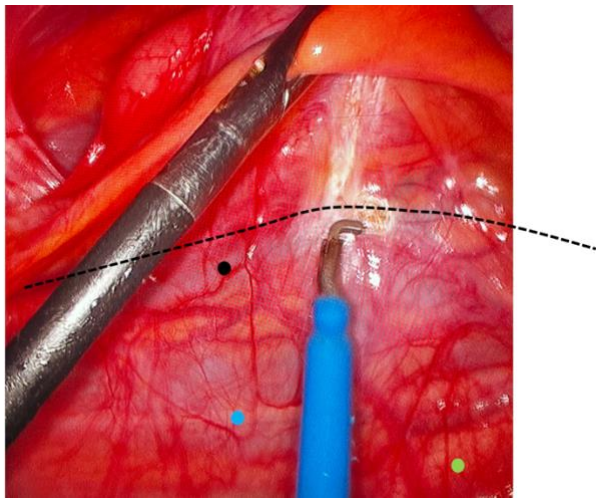
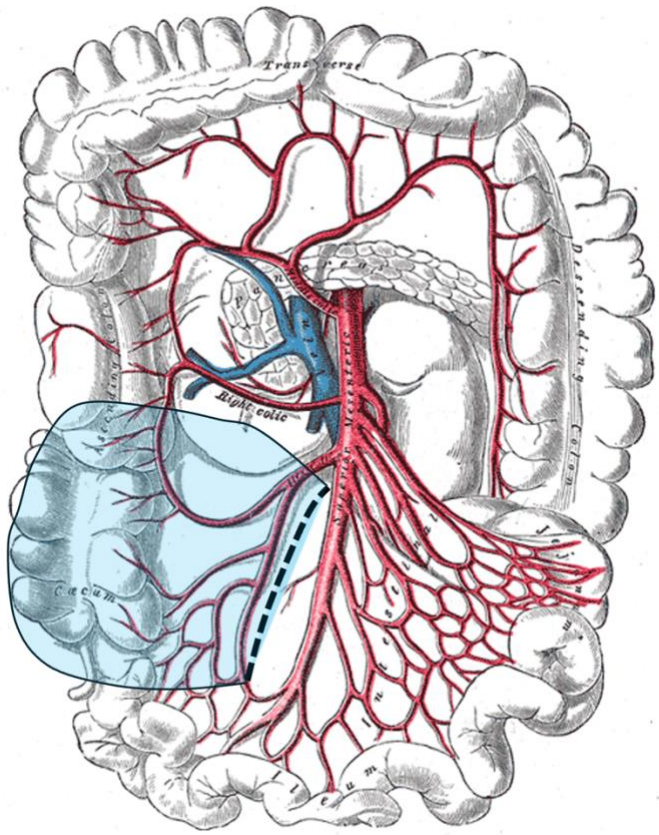


In this photo, the Black grasper is pulling the antimesenteric fat pad of the terminal ileum and the ileocolic vessels anteriorly, away from the retroperitoneum. The patient has minimal body fat and many retroperitoneal structures can be seen through the thin peritoneum. The Black dot shows the right gonadal vein. The Blue dot shows the psoas tendon, running along the anterior surface of the psoas muscle, which can also be seen. The Green dot shows the ureter. In a patient with more body fat, these structures may not be seen until the dissection, as described below.

8. Make a horizontal incision in the peritoneum 10cm in length, about 2cm below the ileocolic pedicle, parallel to it.



With the cecum and terminal ileum retracted anteriorly, the ileocolic vessels will be visible under tension. Make an incision 2-4cm posterior to them, about 8-10cm long, entering into the space between the colon mesentery and the retroperitoneum. Then dissect in that space, in the area shown in Blue above.

9. Begin using blunt dissection to expose the areolar plane between the mesocolon and the retroperitoneum. This plane should develop easily with blunt dissection. We use the diathermy in one hand and a blunt instrument in the other, moving the tips of these instruments apart vertically to open the avascular plane and using the diathermy sparingly for hemostasis or to divide any transparent tissue.

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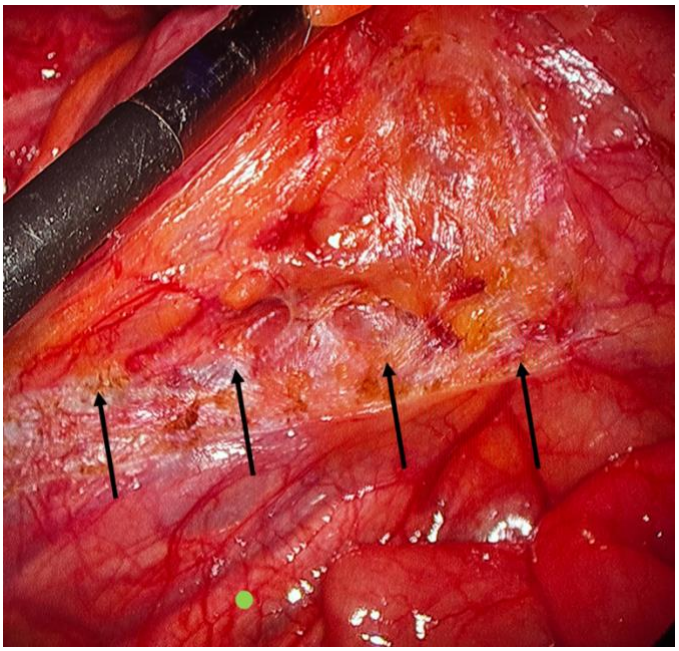
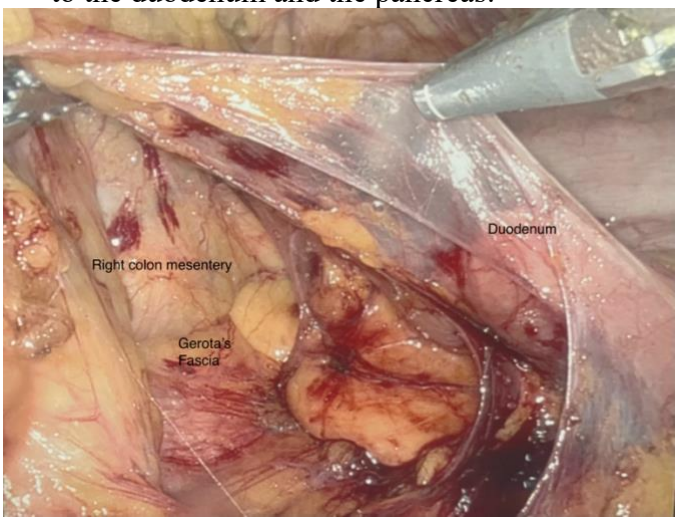
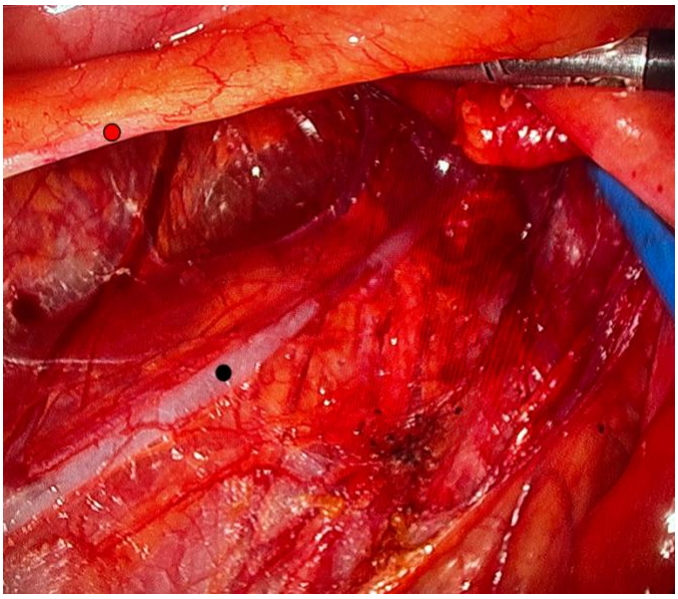


After incising the peritoneum, find the plane between the mesenteric fat and the retroperotoneum and develop this plane. In this patient with minimal body fat, it is easy to see this plane; the inferior edge of the mesenteric fat is shown by the tips of the arrows. The ureter is shown by the Green dot.

10. Laterally, proceed until you have dissected behind all of the ascending colon. Superiorly, continue until the duodenum is exposed. Continue in a cranial direction dissecting anterior to the duodenum and the pancreas.

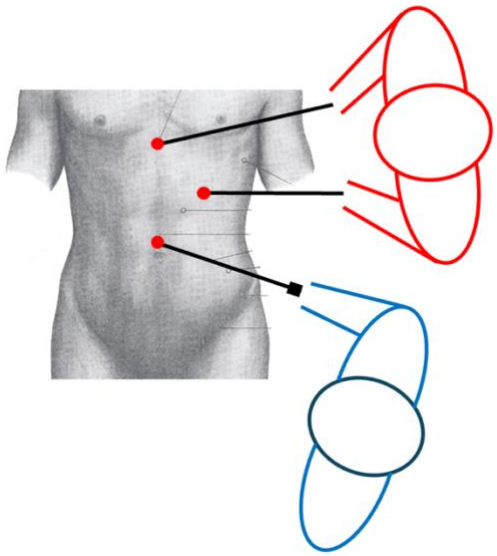


In this photo, the dissection between the retroperitoneum and the colon mesentery is complete. The duodenum is visible to the right of the picture. The right colon mesentery has been dissected and retracted superiorly, while the retroperitoneum and perinephric (Gerota's) fascia is visible inferiorly. Photo courtesy of Caleb Van Essen, MD, with patient permission, St. Mary Hospital, Grand Junction CO, USA



Another photo of the completed dissection. The ileocolic vessels are shown by the Red dot. The gonadal vein is shown by the Black dot. The black instrument in the upper right of the photo is held by the right hand of the camera operator, holding the space open for further dissection.

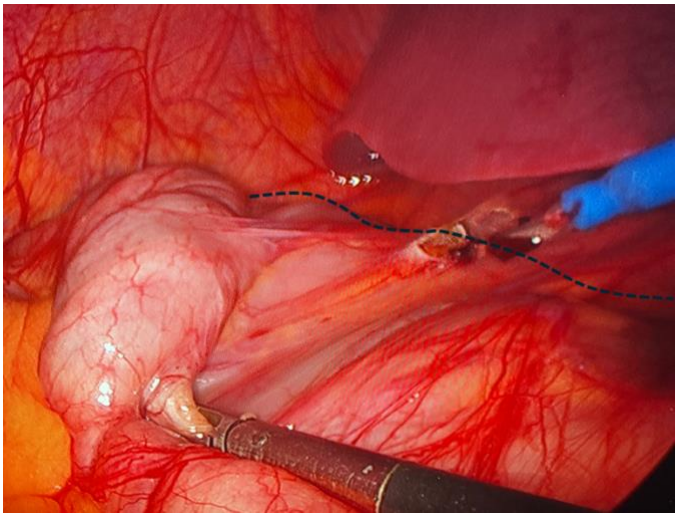
11. Tilt the patient with the head upwards ("Reverse Trendelenburg position"). The surgeon now stands to the right of the camera operator and uses the upper two 5mm ports for steps 12-17 below.



The camera remains in the supraumbilical port. The (Red) operating surgeon now moves to the right of the camera operator (Blue) and operates through the epigastric and left upper quadrant ports.

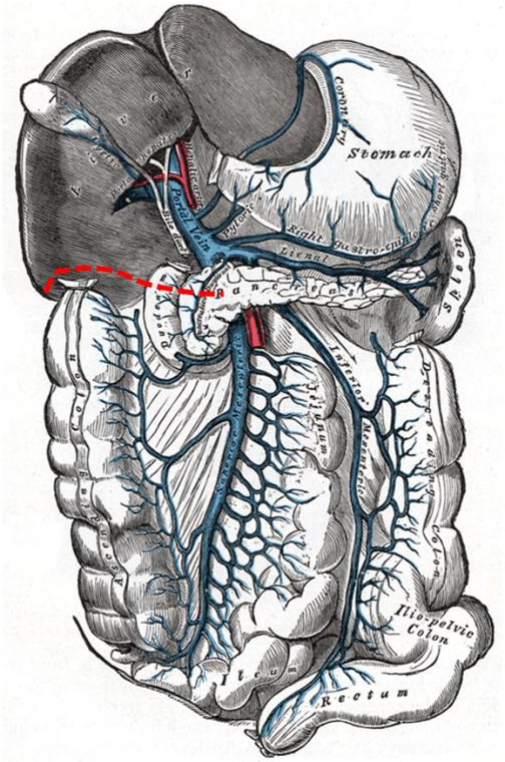
12. Sweep the omentum downwards, exposing the right transverse colon. Grasp the transverse colon

just to the right of midline and pull it in a caudal direction, putting tension on the peritoneum between the colon and the liver.



The surgeon's left hand, holding the black instrument, is pulling the transverse colon caudally, placing the peritoneum between the colon and the liver under tension. The surgeon's right hand, holding the diathermy, then divides the peritoneum along the dotted line as shown. The surgeon periodically regrips the colon so that the peritoneum being divided is under tension.

13. Use diathermy to divide the peritoneum, just cranial to the colon. If there are any vessels here, grasp them with a grasper and apply diathermy to the grasper, or hook them with the diathermy. Bleeding here, if it occurs, is usually inconsequential. Be aware of the duodenum and pancreas, which will be right below the colon, and avoid injuring them with the diathermy.



The peritoneal attachments between the transverse colon (not shown) and the liver are divided as shown by the Red line. This incision passes close to the duodenum, so the surgeon should be careful not to injure this structure.

14. Continue towards the patient's right, grasping the colon adjacent to where you want to divide it and pulling it caudally, away from the liver, until you reach the hepatic flexure, the point where the ascending colon meets the transverse colon.

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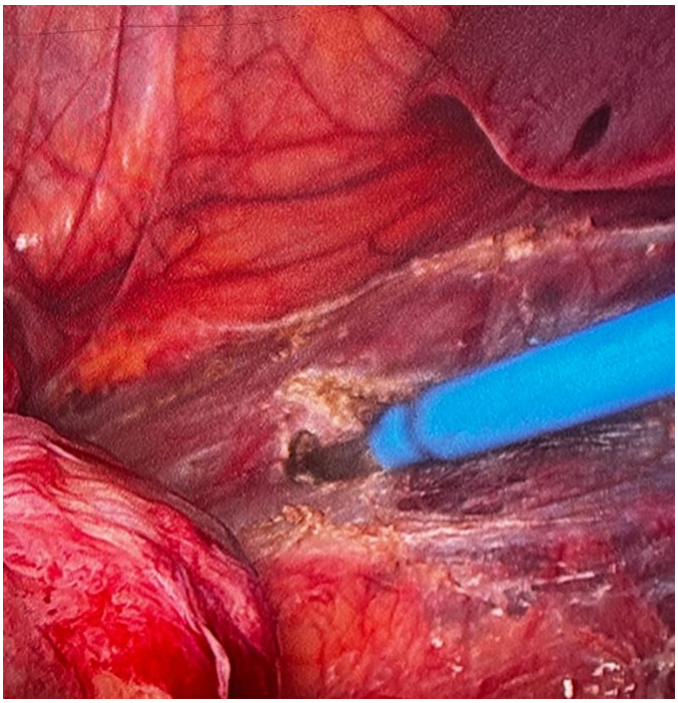
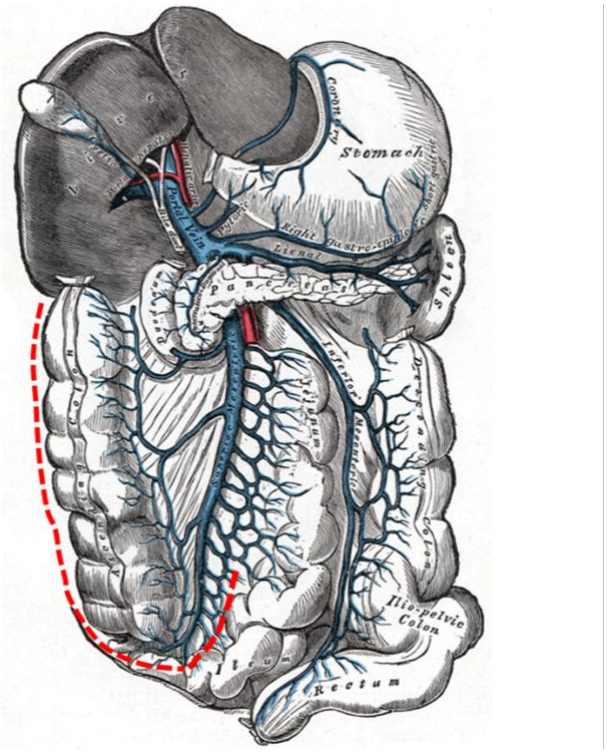


Completed dissection of the right hepatocolic ligament. Because the patient's position is reverse Trendelendburg and left side rotated down, the transverse colon falls away from the liver and can be swept further down bluntly as described below.

15. Go back to the area you have divided and bluntly sweep the transverse colon towards the patient's feet, entering into the plane between the duodenum and the colon that you saw earlier. This blunt dissection will likely enter into the plane of dissection that you created in step #9.
16. The final laparoscopic step of this operation will be to divide the peritoneal attachments of the right paracolic gutter (the "White Line of Toldt"). The upper half of this step will be done in the same position you are in, with the patient's head upwards and the surgeon using the upper two 5mm ports.



The final stage of peritoneal division can now be done, dividing all of the peritoneum that remains in the right paracolic gutter ("White Line of Toldt") and tethering the cecum to the retroperitoneum. Once this step is complete, the right colon and right transverse colon will be fully mobilized.

17. Grasp the colon adjacent to the ending of the transverse incision you made in step #13 and pull it towards the midline. Continue incising peritoneal attachments adjacent to the colon, moving in a caudal direction. Once again, you may find that you are entering into the plane you dissected in Step #9. Go as far caudally as you can, until exposure becomes difficult because of the patient's position.

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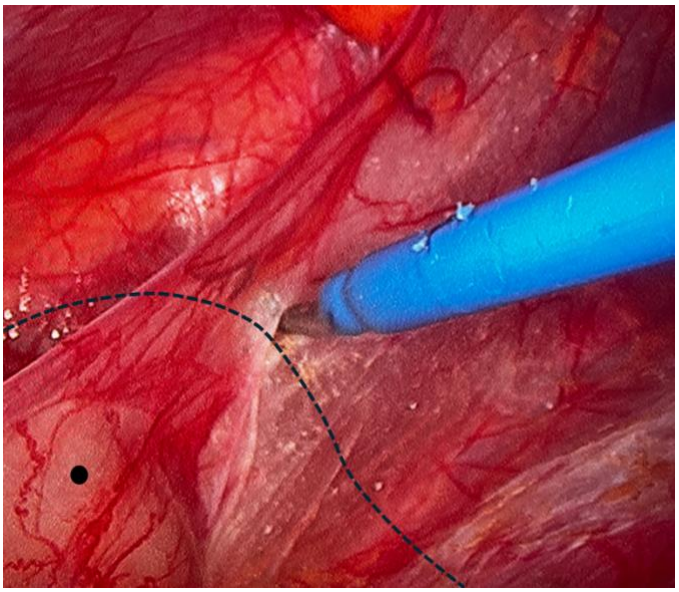

The instrument in the surgeon's left hand (not shown) is pulling the hepatic flexure of the colon caudally and medially. The diathermy continues the division of the hepatocolic ligament, curving it around the hepatic flexure of the colon and downwards into the right paracolic gutter. By continually regripping the ascending colon and retracting it medially as you proceed in a caudal direction, you can divide the peritoneum of the paracolic gutter all the way down to the cecum.

18. Tilt the patient's head downwards again ("Trendelenburg position") and return to the lower two operating ports, standing again to the left of the camera operator, as you did at the beginning of the operation.
19. Holding the cecum in your right hand, use diathermy to extend the peritoneal incision you made in Step #8 inferiorly, around the cecum.
20. Retract the cecum medially and continue dividing the peritoneum until you enter into the lower part of the peritoneal attachments of the right paracolic gutter ("White Line of Toldt"). Continue until you meet up with the incision you made in Step #17.
21. The laparoscopic portion of the operation is over. Return the patient to neutral position, but still with their left side tilted downwards. Have your assistant go to the patient's right side, while you stay on the left.
22. Remove the Hasson cannula and extend the incision in a cranial direction, to a total length of about 8cm.
23. Have your assistant insert a retractor into the incision and retract the abdominal wall anteriorly. Position the operative light so that you can see deep inside the abdomen and try to grasp the ascending colon or cecum, using a Babcock forceps.
24. Deliver all the mobilized ascending colon, right transverse colon, and terminal ileum through the incision out of the peritoneum.

The ascending and right transverse colon, now fully mobilized, can be delivered through the small para-umbilical incision, resected, and anastomosis done.

25. Identify the ileocolic pedicle and the terminal ileum. Divide the terminal ileum about 10cm from the ileocecal valve. Grasp the mesentery adjacent to the proximal transected end with a Babcock forceps so it does not return into the abdominal cavity.
26. Identify on the colon where you will divide it. With some traction on the abdominal wall, it is possible to dissect the colon further towards the patient's left, including dissecting the omentum off it if necessary. Identify a pulsatile vessel going into the transverse colon and divide the colon just to the right of where this vessel enters, assuring that the colon side of the anastomosis will be well perfused. Grasp the mesentery adjacent to the distal end of the transected colon so it does not return into the abdominal cavity.
27. Divide the mesentery of the ascending colon, including suture ligation of the ileocolic vessels when you find them. Other large branches will need ligation as well. Be careful at this point not to extend your mesenteric dissection too far medially, endangering the proximal superior mesenteric artery and vein.

28. Pass the specimen off the field. Inspect the cut mesentery again for hemostasis. Make sure that neither the small intestine nor the colon is twisted before making the anastomosis.
29. Perform an anastomosis of the small bowel to the transverse colon, using the techniques described in Intestinal Anastomosis. If the small intestine is significantly smaller than the colon, make a short incision along the antimesenteric side of the small intestine.
30. Approximate the mesentery of the small bowel and transverse colon as much as you can. You may need to retract the skin and abdominal wall to reach all of it. Avoid damaging mesenteric vessels during this step.
31. Withdraw all 5mm ports and close the minilaparotomy incision. Avoid incisional hernia with meticulous attention to proper technique despite the small incision size, as described in Midline Abdominal Incision.

Appearance of the abdomen after fascia and skin closure.

Pitfalls:

- Incisional hernia is a recognized complication of this operation, occurring up to 25% of the time. This may be due to improper closure technique because of the smaller incision, or treating abdominal closure as an "afterthought" when the difficult part of the operation is over. Use careful technique during closure, taking bites 5-8mm apart and 5-8mm deep. Alternatively, use a different incision than midline, either paramedian or transverse for the extraction site. The paramedian incision uses a vertical incision 1cm to the right of the avascular linea alba, though both the anterior and posterior rectus sheaths while keeping the rectus muscle intact. A transverse incision is a simple extension of a horizontal Hasson incision to the right, through the anterior and posterior rectus sheaths and the rectus muscle. In both cases, close the anterior and posterior rectus sheaths separately.
- Not mobilizing the colon mesentery medial enough to have adequate length to bring out your extraction/anastomotic site. If you divide all the peritoneal attachments, any other attachments between the colon or mesentery can be lysed gently with a finger as you are trying to extract the specimen.
- Not taking ileocolic vessels proximal enough to get adequate oncologic lymph node sampling. Alternatively, taking lymph nodes too close to the proximal superior mesenteric vessels can endanger al of the small bowel's blood supply. It is better for the occasional colorectal surgeon to take too few nodes than to damage the blood supply to the bowel, a potentially lethal injury.
- Injury to the duodenum, especially while mobilizing the transverse colon off it. Be aware that it is there when you start using cautery and be sure that the bowel you are retracting caudally is the colon. Ideally the duodenum should be visible as you sweep the colon away from it.
- Injuring right ureter if you are in a plane too deep in the retroperitoneum, mobilizing posterolateral to the kidney. When you enter the plane between the right colon and mesentery, it should be avascular and easy to dissect, coming apart easily with blunt dissection. If this is not the case, you are in the wrong plane, dissecting either within the colon mesentery or within the retroperitoneum.
- Failure to recognize postoperative anastomotic leak. See Recognizing Postoperative Intra-Abdominal Sepsis.

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