

REVIEW

Laparoscopic Right Hemicolectomy - Anatomy and Critical Structures

Samir Delibegovic^{1,2}

Received: 2 June 2021; Accepted: 15 October 2021

ABSTRACT

Laparoscopic right hemicolectomy is a procedure that involves removing the cecum, the ascending colon, the hepatic flexure, the first third of the transverse colon, and part of the terminal ileum. Due to anatomic complexity, laparoscopic surgery for right colon cancer, especially hepatic flexure and transverse colon, is not an easy procedure. Some key steps are quite complicated procedures, so we would like to point out and explain the difficult sites of dissection during a right colectomy.

Keywords: laparoscopic, right hemicolectomy, mesenteric attachments

INTRODUCTION

Laparoscopic right hemicolectomy is a procedure that involves removing the cecum, the ascending colon, the hepatic flexure, the first third of the transverse colon, and part of the terminal ileum (Figure 1).

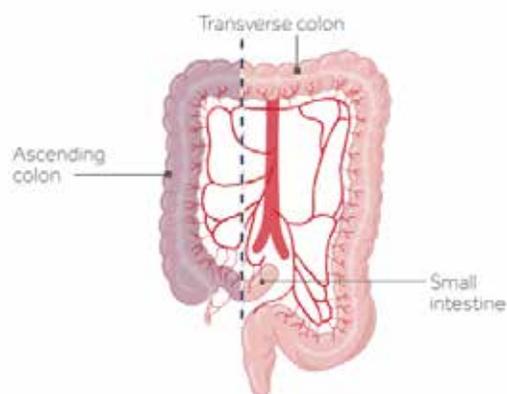


Figure 1. Anatomical presentation of right hemicolectomy.

Due to anatomic complexity, laparoscopic surgery for right colon cancer, especially hepatic flexure and transverse colon, is not an easy procedure, which is why we would like to emphasize the key steps:

The key steps:

- identification of the ileocolic pedicle and incision of the peritoneum along the superior mesenteric artery;

1. Clinic for Surgery, University Clinical Center Tuzla, Bosnia and Herzegovina
2. Faculty of Medicine, University of Tuzla, Tuzla, Bosnia and Herzegovina

Samir Delibegovic

E-mail: delibegovic.samir@gmail.com

Orcid ID: 0000-0003-0525-3288

- dissection of the duodenum, with preservation of the posterior mesocolic fascia; high division of the ileocolic artery at its origin;
- medial-to-lateral mobilization of the ascending colon,
- preserving the posterior mesocolon up to and above the head of the pancreas, and removing attachments to the uncinate process and duodenum;
- identification and division of the right branch of the middle colic artery at its origin, achieving complete mesocolic excision from the ileocolic to the right branch of the middle colic artery;
- division of the greater omentum, resected en bloc with the right colon and exposure of the lesser sac;
- completion of mobilization of the hepatic flexure;
- completion of mobilization of the lateral attachments of the ascending colon and inferior attachments of the cecum; and finally,
- completion of the mobilization of the retroperitoneal attachments of the small bowel mesentery up to the third part of the duodenum¹.

Some of these key steps are quite complex procedures, so we would like to explain these difficult dissection sites.

Mesenteric attachments, the ureter, blood supply to the right colon and variants

The mesentery associated with the small intestine and colon is now regarded as a contiguous and extraperitoneal organ² (Figure 2).

It emerges from the “root region” (as named by Treves), which corresponds to the attachment of the superior mesenteric artery to the aorta, and fans out to span the intestines from the duodenum to the rectum. However, its continuity can only be seen when the mesentery is exposed in a certain way³.

Dividing the peritoneum provides access to the plane formed by the mesentery and the underlying fascia.

When the mesentery is separated from the fascia, the mesentery emerges as a discrete entity (Figure 1).

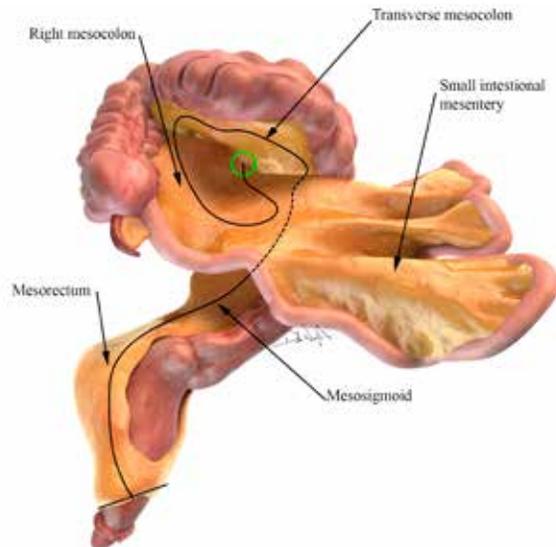


Figure 2. Digital representation of the small and large intestines and associated mesentery. (with the permission of the publisher)

The small intestinal mesentery is mobile, whereas the right mesocolic region is flattened against the posterior abdominal wall². It then changes its conformation to continue as the transverse mesocolon, with another change in conformation at the splenic flexure to continue distally as the left mesocolon (Figure 1).

The mesentery distal to the duodenojejunal flexure can be viewed as similar to a handheld fan, with the central pivot point corresponding to the origin of the middle colic artery from the superior mesenteric artery.

The right and left mesocolic regions and the medial mesosigmoid region curve onto and are flattened against the posterior abdominal wall. They are held attached in these regions by Toldt’s fascia and the peritoneal reflection (Figure 3)^{4,5}.

Suspension and the mesenteric attachment prevent the intestine from collapsing into the pelvis.

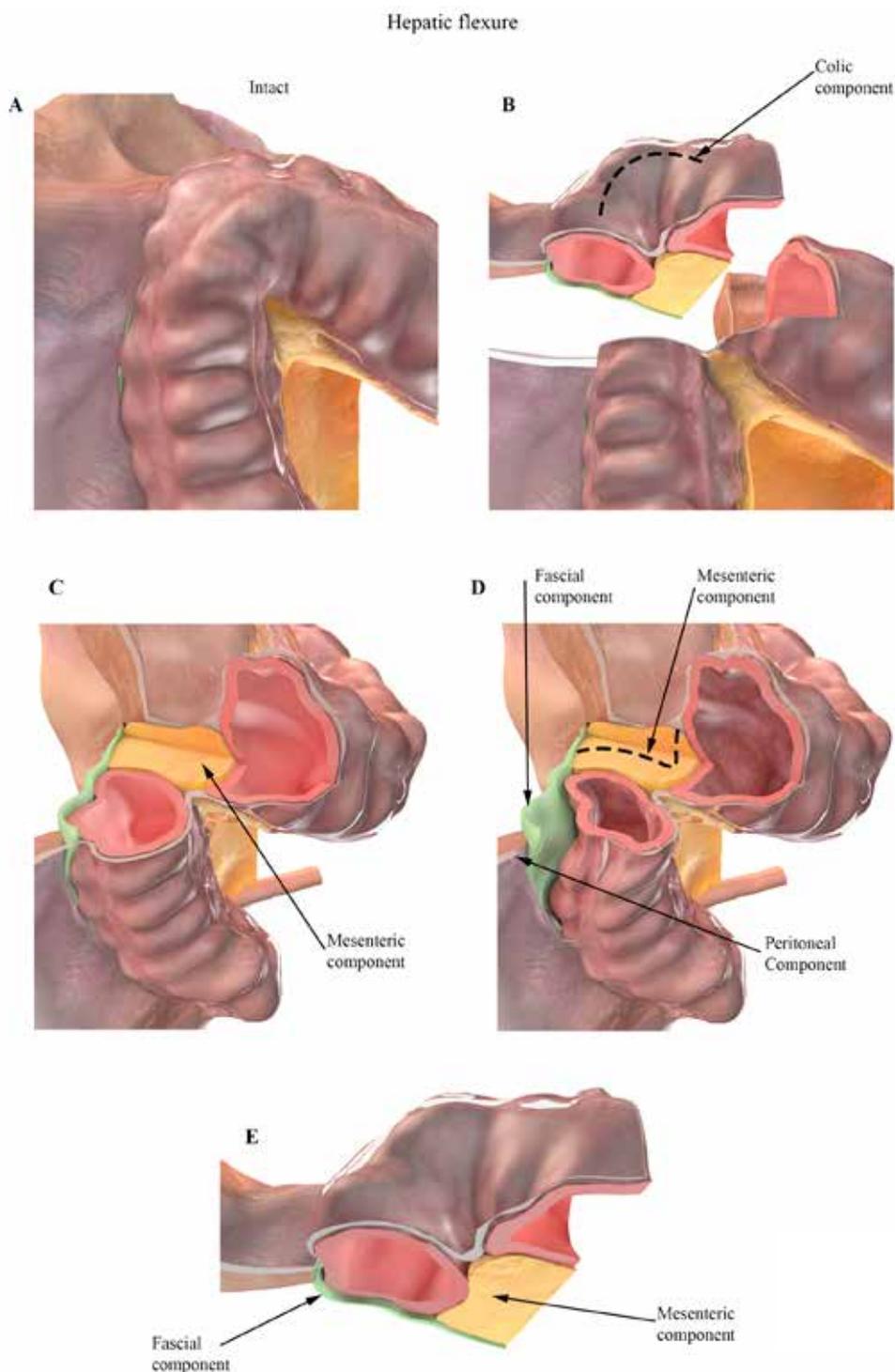


Figure 3. Anatomical components of the hepatic flexure.

Snapshots from a digital sculpture showing (A) the undisturbed hepatic flexure, (B) the flexure separated from contiguous structures, highlighting the colic component, (C) a view of the contiguous mesentery, (D) the divided peritoneal component of flexure, and (E) the fascial component of flexure. (with the permission of the publisher)

The transverse mesocolon consists of a confluence between the mesenteric components of the hepatic and splenic flexure and the middle colic adipovascular pedicle⁴. It forms a caudal limit to the lesser sac.

The greater omentum adheres to the cephalad surface of the transverse mesocolon and partially obliterates this space.

There are six flexures: duodenojejunal, ileocaecal, hepatic, splenic, and those between the descending colon and the sigmoid colon and rectum. All six have contiguous intestinal, mesenteric, peritoneal, and fascial components (Figure 3).

The right and left mesocolon and the medial mesosigmoid and mesorectum are apposed or attached to the subjacent abdominal wall or surrounding pelvis (Figure 3). If attachment does not occur, the intestine and mesentery are suspended on vascular pedicles alone and are thus prone to twisting with vascular occlusion.

Mesenteric attachment facilitates suspension of the colon, allowing it to adopt a spiral conformation.

The right mesocolon is the continuation of the small intestinal mesentery, and it is attached (or anchored) to the posterior abdominal wall throughout its length.

The right mesocolon continues as the transverse mesocolon at the hepatic flexure, and the latter continues as the left mesocolon at the splenic flexure.

At the hepatic flexure, the reflection curves around the colic component of the hepatic flexure, and continues along the lateral aspect of the right colon until it reaches the ileocaecal region. From here it curves around the ileocaecal region and extends along the base of the small intestinal mesentery.

The fascia is readily observed between the right mesocolon and nonmesenteric domain of the abdomen. Surgeons exploit this relationship to access the zone between the fascia and the mesocolon, in order to detach the mesentery from the fascia, and thereby separate the mesentery from the posterior abdominal wall.

The mesofascial plane is formed by the mesentery and the apposed fascia (Figure 3 D). The colo-fascial plane is formed by the colon and the underlying fascia. A colofascial plane occurs wherever the colon is opposed to the posterior abdominal wall (right and left colon and at the flexures)⁶. Division of the right lateral peritoneal reflection exposes the plane on the right.

Once the right lateral peritoneal reflection is divided, this interface is exposed. When the surgeon places it under stretch, by lifting it away from the retroperitoneum, the fascia can either be swept away from the colon, diathermy or sharply divided. By continuing this process, the colon is freed to the point where the mesofascial plane becomes apparent.

The mesenteric and fascial components of the mesofascial plane are contiguous and substantive entities. Upon entry into the abdomen, they are not immediately apparent. To demonstrate these, the overlying peritoneal reflection must be divided.

In general, the peritoneal reflections are identified by the White Line of Toldt, and it is recommended that one begins mobilization or dissection approximately 5 mm medial to the white line (Figure 4).



Figure 4. Dissection along the Toldt white line.

The right lateral peritoneal reflection continues around the hepatic flexure as the hepatic-colic peritoneal reflection. On the right side, division of the right lateral peritoneal reflection exposes the colo-fascial plane. Separation of colic and fascial components brings the surgeon to the mesofascial plane. Similarly, peritonotomy of the hepatic-colic

peritoneal reflection exposes the colo- and mesofascial plane at the hepatic flexure and is an early step in hepatic flexure mobilisation.

An unnamed peritoneal reflection also occurs between the greater omentum and underlying transverse colon. This is appreciated intraoperatively by placing the greater omentum under traction and the transverse colon under counter-traction. Division of this reflection exposes the interface formed by the greater omentum and underlying transverse mesocolon.

Ureter

The path of the ureter is along the anterior edge of the psoas muscle, which is the general area where the gonadal vessels cross anteriorly to the ureter, a third of the way to the bladder. The ureter crosses over the common iliac arteries, showing the anatomical landmark of the bifurcation of the common iliac vessels into the internal and externa iliac vessels.

The right ureter lies in close relationship to the ascending colon, cecum, and appendix (Figure 5).



Figure 5. Position of the right ureter during dissection of the right colon.

To facilitate the surgical overview, the open book model of the fascial and vascular relations is recommended.⁷

Figure 6. Step 1: The correct dissection plane between the retroperitoneum and the ileocolic page can be ensured when the duodenum is viewed from a ventral angle and below (red arrow). The mesenteric

root (dotted line) must consequently be located ventral to the viewer's eye.

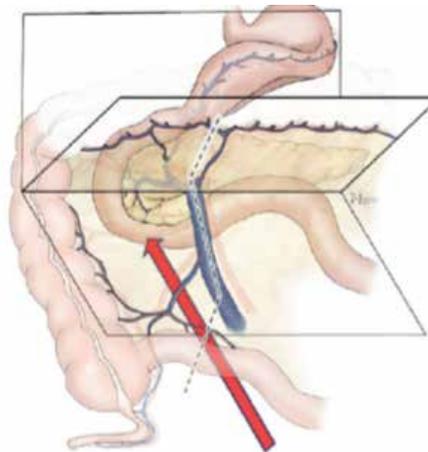


Figure 6. The open book model of the fascial and vascular relations.

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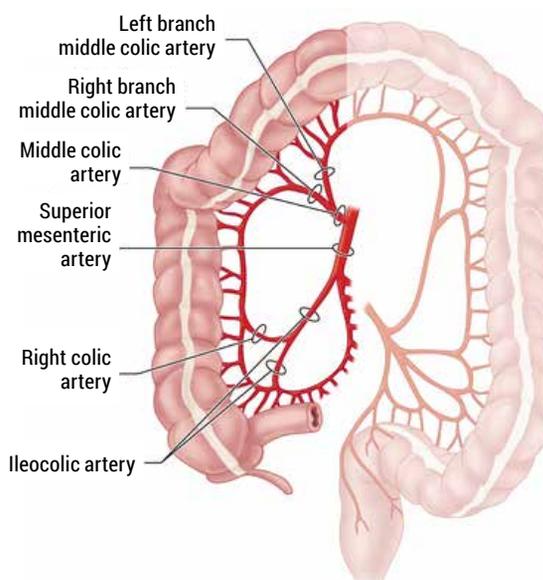


Figure 7. Blood supply of right colon.

Blood supply

The main arterial branches supplying the right colon are the ileocolic artery (ICA) and the middle colic artery (MCA), since both branches are present in all patients, (Figure 7) whereas the right colic artery (RCA) is found in 10%–60% of patients⁸.

One of the most important clinical relationships is the crossing pattern of the ICA and the RCA related to the SMV, as demonstrated in Figure 8.

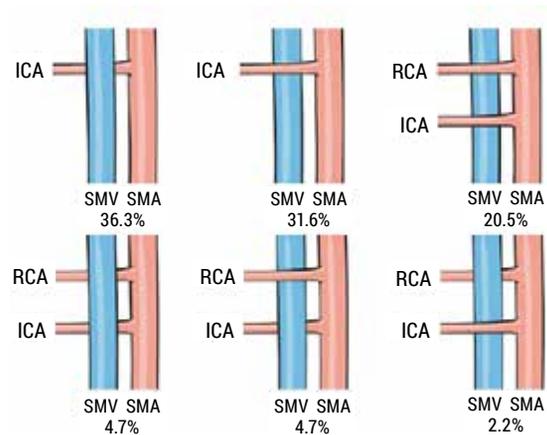


Figure 8. Crossing patterns of the ICA⁸.

The crossing pattern is defined as the ICA and the RCA crossing the SMV, either posterior or anterior, when they arise from the SMA.

The relationships of the RCA and ICA to the SMV are mostly anterior and posterior, respectively, which should be considered during CVL to avoid injuries and for adequate lymphadenectomy. Regarding the MCA, all studies show only the anterior crossing of the SMV.

Initially, all the studies show that the ICA and ICV are present in 100% of all samples⁸.

This finding will strongly support the ileocolic pedicle (ICA and ICV) as a landmark for starting the safe dissection of the mesocolon in the medial to lateral technique (Figure 9).

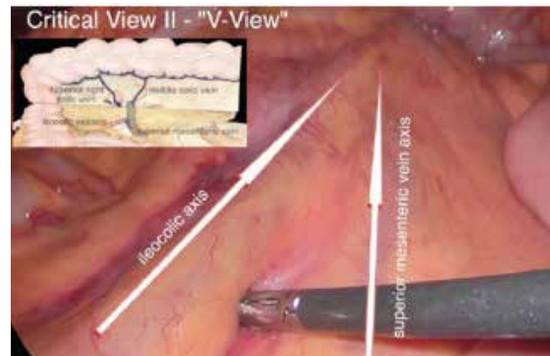
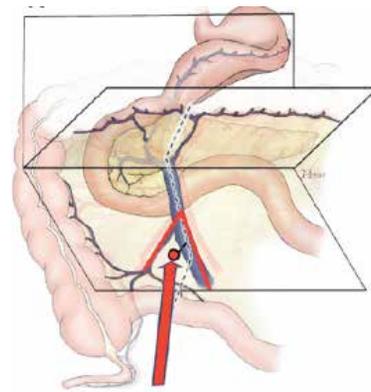


Figure 9. The ileocolic pedicle (ICA and ICV) is a landmark for starting the safe dissection of the mesocolon⁷.

This is why it is important for the division of the ICA and the RCA to be on the left-hand side of the SMV and the MCA (high ligation), with additional removal of related main lymph nodes⁹.

The ileocolic vein (ICV) is defined as the tributary from the ileocecal marginal veins; the right colic vein (RCV) and the middle colic vein (MCV) are defined as tributaries from the marginal veins of the ascending and transverse colon, respectively (Figure 10).

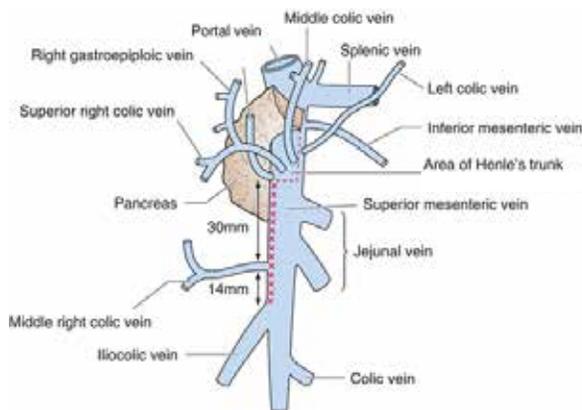


Figure 10. Distribution of veins of the right colon.

The ICV is always present and drains into the SMV, with the exception of one study showing that in 2% of cases, the ICV drained into the GTH and in 98% into the SMV.

MCV The location of the MCV on the pancreatic head was found highly variable among the veins of the right colon, with the main MCV draining directly into the SMV in 84.5% of cases⁸.

The MCV was positioned cephalad to the middle colic artery (MCA) in all cases (100 %).

The main MCV flowed into the SMV in 55 patients (68 %), GCT in 16 patients (20 %), the jejunal vein in 5 patients (6 %), the inferior mesenteric vein (IMV) in 4 patients (5 %), and the splenic vein in 1 patient (1 %) (Figure 11).

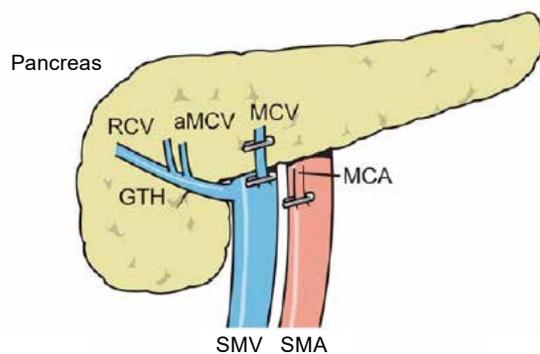


Figure 11. Position of MCA and GTH⁷.

The superior right colic vein (SRCV) is defined as the tributary from the marginal veins of the hepatic flexure.

The gastrocolic trunk of Henle (GTH) is the confluence of the superior right colic vein and the right gastroepiploic vein (RGEV), which drain into the SMV at the inferior border of the neck of the pancreas.

Apparently, the GTH receives venous drainage from the ascending and transverse colon in most patients, mainly from the RCV and the MCV.

Right Colic Vein (RCV)

Generally, the RCV is depicted as joining the SMV directly¹⁰, but actual anatomy has more variations. In one study, the main RCV flowed into the GCT in 68 patients (84 %) and the SMV in 8 patients (10 %)¹¹.

One of the main reasons for targeting the vein is that nodal metastases from the hepatic flexure and transverse colon cancer are sometimes found along the GCT, whereas the major lymphatic drainage follows the colic vessels to the root of the SMA.

The ileocolic and the right colic vessels (if present) are divided at their origin from the superior mesenteric vessel. Sharp dissection is then carried out centrally along the superior mesenteric artery, ensuring clearance of all associated lymph nodes.

Conclusion

The anatomy of the right colon is complex, but bearing in mind the key steps of right hemicolectomy, and taking note of the complex anatomic sites, right mesocolic excision becomes a standard laparoscopic procedure.

Conflicts of interest

The authors have no conflict of interest.

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