“How I Do It”—Radical Right Colectomy with Side-to-Side Stapled Ileo-Colonic Anastomosis

M. Hübner · D. W. Larson · B. G. Wolff

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Abstract

Background and Objective Standardization of surgical technique helps to reproduce excellent clinical outcomes, especially in teaching institutions. We aim to describe in detail our established approach for oncological right colectomy.

Technique The right colon is mobilized in a five-step latero-inferior approach starting off with (1) the terminal ileum, visualizing the duodenum and the head of pancreas. (2) The ascending colon is dissected from the retroperitoneum, and takedown of the hepatic flexure is completed coming retrograde from the transverse colon (3). (4) Transection of the remaining retroperitoneal attachments completes exposure of the duodenum and mobilization of the right colon. (5) Ileocolic vessels are dissected out and divided close to their origin, and the mesocolon is divided.

We then establish intestinal continuity by use of a side-to-side stapled technique. (1) The arms of a linear cutting stapler are inserted via transverse incisions at the anti-mesenteric sides of the terminal ileum and the transverse colon (tenia) and fired. (2) The enterotomy site is closed by removal of the specimen using a second transverse firing of the linear cutting stapler. An important final step is the (3) reinforcement of the anastomotic ends and the crossing of the staple lines; an omental patch and closure of the mesenteric window are optional.

Conclusion The suggested standardized five-step lateral-to-medial dissection of the right colon and the three-step side-to-side stapled technique for ileo-colonic anastomosis are easy to learn and to reproduce. Careful adherence to pivotal technical details will help to obtain an optimal oncological outcome and a consistently low leak rate around 2 %.

Keywords Surgical technique · Right colectomy · Stapled anastomosis

M. Hübner · D. W. Larson · B. G. Wolff (✉)
Department of Surgery, Division of Colon and Rectal Surgery,
Mayo Clinic,
200 First Street SW,
Rochester, MN 55905, USA
e-mail: wolff.bruce@mayo.edu

M. Hübner · D. W. Larson · B. G. Wolff
Colon and Rectal Surgery, Mayo Clinic,
Rochester, MN, USA

M. Hübner
Department of Visceral Surgery, University Hospital CHUV,
Rue du Bugnon 46,
1011 Lausanne, Switzerland

D. W. Larson · B. G. Wolff
College of Medicine, Mayo Clinic,
Rochester, MN, USA

Introduction

Right colectomy (RC) is for many surgical residents their first colon resection since it is a common operation in general and colorectal surgery, and is considered to be easy to perform and safe. However, a nationwide study comparing clinical outcomes in over 50,000 patients after RC and left-sided resections confirmed an equally high postoperative morbidity in about 30 % of the patients.¹

Enhanced recovery pathways have allowed decreasing morbidity after colon resection by up to 50 %;^{2–4} those benefits are mainly restricted to medical complications while the incidence of surgical complications remains typically unchanged.^{5,6} Anastomotic leak rates after RC are

reported by most authors to be as low as 1–3 %, while other reports suggest over 5 %.^{1,7–11} Individual surgical skills might provide an explanation for those differences. Even so, surgeons-in-training have been shown to achieve excellent results when trained in a dedicated institution.¹² What is the key to success?

The main goals for oncological RC are (1) a complete (RO) and radical resection of the primary tumor site including the lymphatic drainage area with (2) a low morbidity and anastomotic leak rate around 2 % or less. A standardized surgical approach is essential, especially in the setting of teaching institutions. Requirements for the ideal anastomosis are to be simple, fast, and safe in order to be easily reproducible.

We therefore offer a detailed description of *our* preferred approach for oncological right colectomy. The described technique has been consistently performed over the last two decades,¹³ and has proven to be a valid technique even with the advent of laparoscopic surgery.⁸

Technique

The described technique is essentially performed in the same manner by open and laparoscopic approach. The exact position of the tumor dictates the extent of resection. The ileocolic and right colic (if present) vessels are ligated at the origin from the superior mesenteric artery. In order to remove the entire lymphatic drainage territory, resections of cecal or proximal tumors should include about 10 cm of the terminal ileum, while more distal (ascending colon) tumor resections require ligation of the right branch of the middle colic artery (Fig. 1d).

General Considerations

Patients are placed in supine position with both arms tucked along the body. Ankle and chest straps as well as a gel mattress secure the patient's position on the operating table to allow for an extreme Trendelenburg position, which is of particular importance for laparoscopic colectomy. The surgeon stands typically on patient's left side while his first assistant is opposite or on his right side for open and laparoscopic procedures, respectively. We access the abdomen via a periumbilical midline laparotomy that rarely exceeds 15 cm. For laparoscopic RC, we use a three- to four-trocar technique in diamond fashion with the right port being optional; anastomoses are performed extracorporeally via a 5–7-cm midline laparotomy.

Lateral-to-Medial Dissection—Five Steps

1. The mobilization of the right colon is started by an inferior approach (Fig. 1a). The patient is placed in steep Trendelenburg position with a tilt to the left side.

Incision of the peritoneum at the pelvic brim permits dissection of the terminal ileum and cecum medially and upwards. The retroperitoneal fascia is carefully left intact, and the right ureter and gonadal vessels are identified and spared. The third portion of the duodenum and the head of the pancreas are visualized and separated from the mesentery to complete the inferior part of dissection.

2. The fully mobilized cecum is elevated progressively towards the left upper quadrant exposing the transparent lateral peritoneal attachments that can be incised easily (Fig. 1a). It is important not to lose the correct dissection plane that tends to be close to the colon. Most of this part can be done by blunt dissection pushing the retroperitoneal fascia from the colon downwards until the ascending colon is completely mobilized (Fig. 1b).
3. The hepatic flexure is approached in a retrograde fashion starting from the transverse colon. The patient's position is switched to reverse Trendelenburg. The right transverse colon is pulled upwards and inferiorly bringing the gastrocolic ligament under traction. The thin colo-hepatic peritoneum is most easily incised close to the gallbladder, and the transverse colon mesentery is progressively pushed downwards (Fig. 1c). This maneuver meets the previous plane of dissection in order to complete the takedown of the hepatic flexure.
4. The mobilization of the mesocolon is completed by careful dissection from the second and third portion of the duodenum. This part is frequently neglected but is indispensable for a safe and oncologically radical high ligation of the ileocolic vessels.

Steps 1–4 can usually be performed with electrocautery only, and thus, more expensive energy devices are rarely needed. However, care must be taken not to pull on the mesentery as vessels of the superior mesenteric plexus at the base of the mesentery can easily be torn resulting in vigorous bleeding.

5. Vessel control is mostly achieved intracorporeally for laparoscopic procedures in order to achieve high ligation with small incisions. In our practice, main vessels are sealed by use of a bipolar vessel sealer (laparoscopic), while we prefer standard suture ligation in open cases. Preparation of the ileocolic vessels is guided by the avascular transparent areas on both sides of the vascular trunk (Fig. 1d). The right colic artery and right branch of the middle colic artery are separately taken if present and indicated, respectively. The dissection is terminated by complete transection of the mesocolon and mesentery to the predetermined proximal and distal transection points. The proximal transection follows parallel to the ileocolic artery, while the distal dissection should spare the middle colic artery in most cases depending on tumor location (Fig. 1d).

Fig. 1 The five-step lateral-to-medial dissection of the right colon. (1) The right colon is mobilized by an latero-inferior approach. The terminal ileum is lifted up, and the peritoneum is incised, visualizing the right ureter and gonadal vessels (a). Retroperitoneal dissection is completed by visualization of the duodenum and the head of pancreas. (2) The ascending colon is pulled up and medial and the peritoneum of the right colonic gutter is incised antegrade up to the hepatic flexure (b). (3) The right transverse colon is freed from the omentum, and the takedown of the hepatic flexure is completed in a retrograde fashion (c). (4) The mobilization of the right colon is completed by dissection of mesocolic attachments to the duodenum and the retroperitoneum. (5) Ileocolic vessels (and right colic vessels if present) are individualized close to their origin incising the transparent areas on both sides of the vascular bundle. Arteries are taken distal from their origin from the superior mesenteric artery (d). The mesocolon is divided along the ileocolic vessels and towards the right transverse colon by careful preservation of the mid colic artery

In laparoscopic procedures, extraction is prepared after this final step by a 5–7-cm periumbilical midline incision and is eased by placement of a wound retractor.

Side-to-Side Stapled Ileocolic Anastomosis—Three Steps

The proximal ileal and the distal colonic transection points are defined and freed up from fatty attachments. The mesentery is divided about 2 cm towards the remaining bowel ends to prepare for transverse stapling (Fig. 2b). The described anastomosis is a formal side-to-side antiperistaltic anastomosis, which is by use of a long linear cutting stapler (75–100 mm) creating a widely patent functional end-to-end connection.

1. Small transverse incisions of 5 mm are made on the tenia and the anti-mesenteric ileal border of the specimen sides and gently dilated. Babcock clamps are placed in order to

allow for easy insertion of the linear cutting stapler (Fig. 2a); the small side of the device is inserted into the small bowel, and the large one enters the large bowel. The stapler is closed by bringing the ileum on top of the less mobile colon (Fig. 2a). Traction on the Babcock clamps prevents slipping of the stapling device and helps to correctly align the bowel ends preventing inadvertent perforation. The stapler is gently closed, and interposition of the mesentery is ruled out (Fig. 2b). The staple device should ideally stay in place for about 15 s to allow for tissue compression before cutting.

2. The unified enterotomy site is transversally joined using the Babcock clamps. Care should be taken to precisely approximate the anterior and posterior aspect of the horizontal staple line (Fig. 2c). The linear cutting device is placed in transverse fashion across the ileocolic anastomosis. The joined enterotomy site is held under traction

Fig. 2 The three steps of side-to-side stapled ileocolic anastomosis. (1) The branches of a long linear cutting stapler are inserted via transverse incisions at the anti-mesenteric sides of the terminal ileum and the transverse colon (tenia). The mobile terminal ileum is brought on top of the transverse colon, and the stapler is closed (**a**). Before the stapler is fired, we test its position to avoid injury to or interposition of the mesentery into the staple (**b**). (2) Three to five Babcock clamps are

used to close the enterotomy site and to align the anterior and posterior aspect of the horizontal staple line. The defect is closed by a second transverse firing of the linear cutting stapler, and the specimen can be removed (**c**). (3) The crossing of the staple lines (**A**) and the extremities of the transverse (**B**) and horizontal (**C**) staple lines are reinforced by four interrupted sutures using a slowly resorbable monofilament suture material (e.g., polydioxanone 4–0)

by the Babcock clamps, and the enterotomy site and specimen are removed by firing the linear cutting stapler.

3. The staple lines are reinforced by four sutures placed at the three notorious weak spots: (a) the root point of the horizontal staple line, (b) inversion of the two “dog ears” on both ends of the transverse staple line, and (c) U-stitch to secure the “angle of sorrow” at the crossing of transverse and horizontal staple line (Fig. 2d). Oversewing of the entire staple line is not necessary; an omental patch to cover the oversewn staple lines and closure of the mesenteric window for prevention of an internal hernia are optional steps; those additional measures should only be considered if easy to perform.

Discussion

Right colectomy by latero-inferior approach with side-to-side stapled anastomosis is the preferred approach for open and laparoscopic oncological RC in our institution. The described stepwise approach helps to reproduce excellent outcomes in a teaching institution.

It is beyond the focus of this article to review in detail *pros* and *cons* of different approaches for RC such as (1) laparoscopic vs. open, (2) lateral vs. medial approach, or (3) hand-sewn vs. stapled anastomosis. Briefly, (1) laparoscopic surgery has been shown in three large-scale randomized trials to be at least equivalent in terms of postoperative morbidity,

anastomotic leak, and completeness of oncological resection.^{7,9,11} Potential short-term benefits by laparoscopic approach are likely to be only minimal within standardized enhanced recovery pathways,^{2–4} but approaches can hence be considered equivalent. Very little data have been published comparing (2) lateral vs. medial approach, but excellent outcomes have been achieved by either technique.^{8,14} (3) A recent Cochrane review included seven trials comparing 441 stapled with 684 hand-sewn ileocolic anastomoses. The main finding was a significantly lower anastomotic leak rate (OR 0.48) with a stapled anastomosis.¹⁵

Many different techniques have been described, and in expert hands, either technique is probably safe. It is important however to keep in mind the learning curve that is considerable especially for laparoscopic procedures;^{12,16} it has been shown nevertheless that continuous resident training in specialized centers does not preclude excellent clinical outcomes.^{12,16} The key is a standardized and relatively simple technique that enables the learning surgeon to fulfill the imperative goals (e.g., complete resection and minimal morbidity) even without outstanding manual skills. For hand-sewn anastomoses, one single inaccurate stitch can jeopardize the entire construction, or an overly “generous” double layer will probably result in an anastomotic stricture. In contrast, there should be little difference between a novice and an expert in firing a stapler. Respecting only a few details, the final result is a safe and widely patent connection.

Stapled functional end-to-end anastomosis has been suggested five decades ago to simplify and hasten creation of the anastomosis and to overcome anastomotic stricture.¹⁷ The senior author (BGW) introduced a modified technique in our department using two firings of one single linear cutting stapler instead of two different staplers, e.g., a linear cutting and a linear non-cutting device; this simplified technique has been unchanged for the last 20 years.¹³ Over 1,000 right colectomies have been performed since, and leak rates were consistently below 2 %.^{8,18} A rigorous enhanced recovery protocol including preoperative analgesia, intrathecal injections, limited intravenous fluids and opiates, and early feeding permitted the reduction of median hospital after colorectal resections to only 2–3 days.¹⁹

The strength of our approach is a comprehensible step-wise dissection that is essentially the same for laparoscopic and open procedures. The stapled anastomotic technique is less prone to individual failure and helps to achieve excellent outcome in teaching institutions.

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