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Emergency Treatment of Transverse Colon Cancer

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Abstract

This chapter deals with the emergency treatment of transverse colon cancer. The main complications that classify transverse colon cancer in an emergency setting are obstruction, perforation accompanied by localized or generalized peritonitis, and hemorrhage which may be occult or cataclysmic with hemorrhagic shock. We present the technical principles of radical surgical resection using embryological, anatomical, and oncological concepts. In this chapter we also discuss the principles of lymphadenectomy associated with complete excision of the mesocolon with high vascular ligation, in particular with T3 or T4 cancers requiring D2/D3 lymphadenectomy. The use of infrapyloric, gastro-epiploic, and prepancreatic lymphadenectomy is recommended due to the frequent metastases in these regional lymph nodes.

Keywords: transverse colon cancer, emergency, transverse cancer, colon cancer

1. Introduction

The incidence of transverse colon cancer in an emergency setting is approximately 77–80%. Five percent of all colon cancer are located at the level of transverse colon, hepatic flexure cancer represents 3% whilst splenic flexure represents 2% [1, 2]. The complications associated with transverse colon cancer are represented by large bowel obstruction, tumor perforation, or more commonly diastatic perforation and hemorrhagic syndrome [3].

Based on embryological and anatomical considerations, the colonic frame can be divided into the proximal (“right”) colon represented by the cecum, the ascending colon and the proximal or right 2/3 of the transverse colon, and the distal (“left”) colon represented by the distal 1/3 of the transverse colon, the descending colon, the sigmoid colon, the rectum and the proximal 2/3 of the anal canal [4–7].

Since the proximal colon is derived from the midgut the incidence of transverse colon cancer is higher in females. Thus, mucinous tumors are more common, which present an increased risk of genetic mutations ↑ CIMP, ↑ BRAF, ↑ MSI, ↑ CMS1, ↑ CMS3, ↑ KRAS, and where survival has a limited prognosis compared to distal colon cancers [8–10].

The recommended surgical technical principles for proximal colon cancer complications are simple and are represented by resection and anastomosis in the

first intent in most scenarios, while in the case of distal colon cancer complications, surgeons perform resections and colostomies (terminal or loop colostomy) or in rare cases of hemodynamically stable patients, per-primam anastomoses.

The majority of transverse colon tumors and their complications follow the general characteristics of colorectal cancers. Thus, in an emergency setting, patients have already developed complications the disease is generally found in advanced stages (T3-T4) [11]. Due to the presence of complications at the time of diagnostic, radical intent surgery is most of the time impossible; surgeons cannot perform a radical D2 or D3 lymphadenectomy, due to local cancer spread and the technical impossibility to remove the tumor together with the anterior and posterior sheets of the visceral peritoneum. To follow Hohenberger principles introduced in 2009 [12] to completely resect the mesocolon and perform high vascular ligation, in the case of complicated transverse colon cancer becomes impossible in most cases [12, 13].

Embryologically, the small intestine starting from D3, the cecum, the ascending colon, and the proximal or right 2/3 of the transverse colon derive from the midgut. The vascular supply is represented by ileocolic vessels, right colic artery, and middle colic artery, all derivative from superior mesenteric vessels. The parasympathetic innervation of these segments of the intestine is represented by the vagus nerve.

For the distal third (or left third), the descending colon, sigmoid, rectum, and the proximal 2/3 of the anal canal the embryological origin are represented by the hindgut and the vascular supply by the left colic branches of the inferior mesenteric vessels. The parasympathetic innervation is represented by the pelvic splanchnic nerves S2-S4. The transition zone from the parasympathetic vagal to the sacral is called the Cannon-Bohm point [14]. This corresponds to Griffith's point where Drummond's marginal arch anastomoses with the ascending branch of the middle colic artery [15].

2. Anatomical particularities

The proximal colon is anatomically the most dilated segment in the colonic frame, having the largest diameter at the level of the cecum (8 cm), while the ascending colon being is 6 cm in diameter and the transverse colon 5 cm. The transverse colon is the longest segment of the colic frame, having a length of about 50 cm as well as being the most mobile segment of the colon [16].

The arterial sources of the ascending colon are represented by the branches of the superior mesenteric artery. They are the ileocolic artery, the right colic artery which may be inconsistent, the middle colic artery with the right and left branches, the left colic artery with the ascending branch which has its origin in the inferior mesenteric artery. In addition to these arterial sources for each segment, some anastomoses from the marginal artery of Drummond (MA) – the marginalis colic artery (*arteria marginalis coli*), the anastomotic source between the superior and inferior mesenteric artery [14, 17]. Another important anastomotic arterial source, also the anastomosis between the two important arterial sources, is represented by Riolan's arch, also called Moskowitz's arch or meandering mesenteric artery. An important aspect of this marginal arch is present in the splenic flexion, the so-called Griffith area in which there is the possibility to interrupt this arterial anastomosis, thus having direct implications in resections of the transverse colon or splenic flexure [14].

Thus, colon resections regardless of the region are segmental resections. This principle was introduced and accomplished with the sigmoid colon segment by Jean-Francois Reybard in 1833. Later this type of resection extended to the transverse colon, becoming a transversectomy. Also related to the name of this surgeon, Reybard is also linked with the first right hemicolectomy, performed in 1832.

3. Lymphatic drainage

Colic frame lymph nodes are present according to the Japanese Society for Cancer of the Colon and Rectum (JSCCR) in four areas:

- D1 or N1 lymphatic centers – epicolic/paracolic
- D2 or N2 lymphatic centers – intermediates
- D3 or N3 lymphatic centers – central
- D4 or N4 lymphatic centers – located on the anterior face of the large retroperitoneal vessels [18].

Thus, segmental, limited, or extensive resections for transverse colon cancers follow Hohenberger's recommendations for mesocolon excision and central vascular ligation [19, 20].

There are several comparative studies between D2 or D3 lymphadenectomy recommendations for locally advanced cancers, that often present themselves in the emergency department. They do not show a clear advantage of D3 over D2 but recommend performing D3 lymphadenectomy to obtain a radial resection margin and a larger number of lymph nodes necessary for accurate staging [21–23]. The minimum number of lymph nodes required for an accurate staging is 12 [2, 24, 25].

Transverse colon cancer frequently metastasizes to the lymph nodes of the infra-pyloric lymph nodes, pancreatic cephalic nodules, and gastro-colic ligaments [26].

Another aspect used in surgical resections of transverse colon cancers is resection of the hepatic or splenic flexures. It is, therefore, necessary to define this flexure, anatomically. There is no general surgical concept but the most common limit is represented by a portion of 10 cm belonging to the ascending or descending colon, respectively 1/3 corresponding to the transverse colon. The splenic flexure is always located higher, and more angled, often creating an additional obstacle [14].

4. Therapeutic principles

4.1 Large bowel obstruction

Large bowel obstruction – is the most common complication of colorectal/rectal colon and transverse colon, representing about 77% of the entire volume of complications [27, 28]. The most common symptom is the lack of bowel movement in a patient with intestinal transit disorders. Due to the relatively large diameter of the proximal colon, ascending and transverse, the tumors become palpable, giant even, a long time before producing mechanical occlusion [29].

In this situation, the technical principle is segmental resection (**Figure 1**) represented by the right hemicolectomy, detailed by Kohler and Mikulicz or extended to the right, towards the left of the middle colic vessels followed by an ileocolic anastomosis or the segmental resection (transversectomy) followed by end-to-end anastomosis. There are divergent views and, in this regard, many articles and studies show that limited resections, such as transversectomy are more effective [24, 30].

If the location of the tumor is at the level of the hepatic flexure, then the common surgical procedure is a standard right hemicolectomy, with right omentectomy and

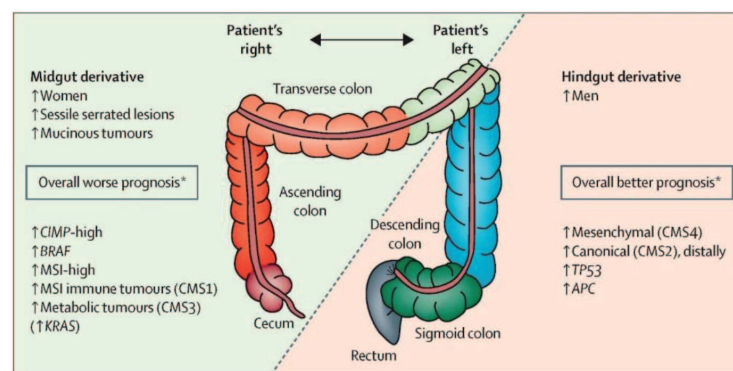
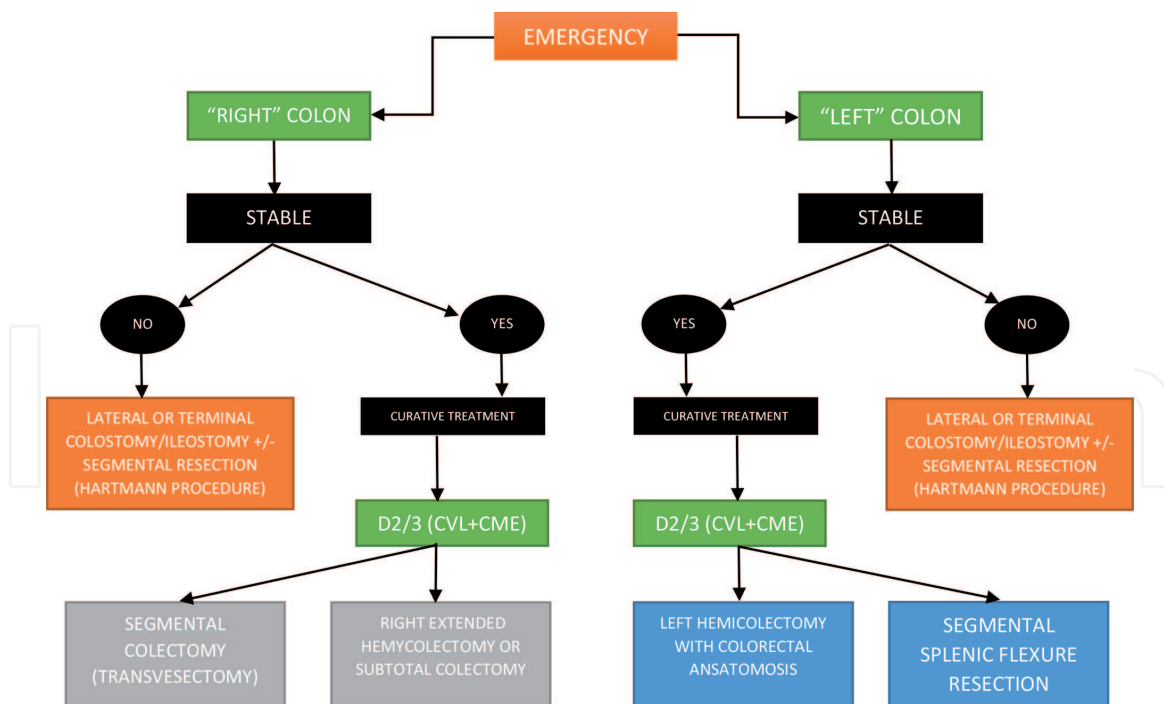


Figure 1.
Surgical approach of the colon.

ligation at the origin of the ileocolic vessels, right colic, and of the right branch of the middle colic vessels, followed by an ileo-colic end to end anastomosis (**Figure 2**).

If the obstructive tumor is located at the middle of the transverse colon, then you can opt for a transversectomy with omentectomy and resection of the mesocolon (**Figure 3**), and high ligation at the origin of the middle colic vessels. If the local anatomy is favorable, namely after an adequate mobilization of both the hepatic and the splenic flexure if we can obtain a resection margin of about 10 cm, then we can opt for a tension-free anastomosis. If the local anatomy is not favorable, it is recommended to perform an extended right hemicolectomy with omentectomy and high ligation of the vascular pedicles followed by an ileocolic anastomosis. This type of anastomosis is classified with the lowest fistula rate [24, 30–32].

If the occlusive tumor is located at the left third of the transverse colon, then an extended right hemicolectomy is recommended as long as we obtain an adequate distance resection margin as well as an adequate radial resection margin – all by maintaining the integrity of the visceral peritoneum sheets.

Location of the tumor at the level of the splenic flexure may be followed by segmental resection of the splenic angle, left omentectomy, resection of the mesocolon

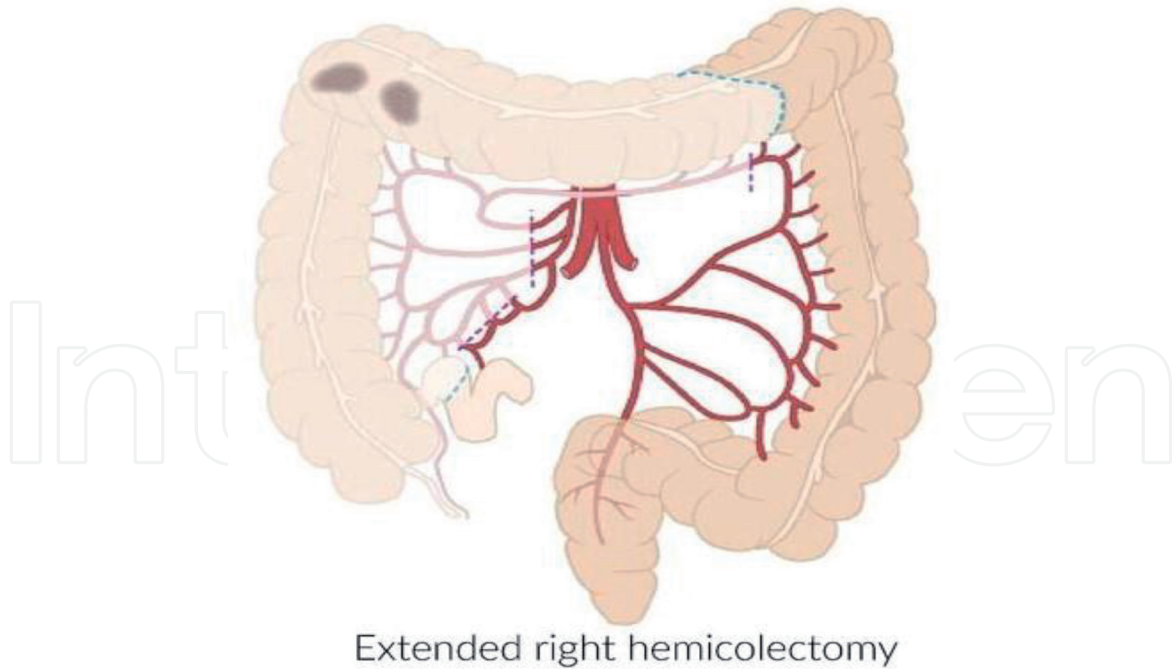


Figure 2.
D2/3 extended right hemicolectomy.

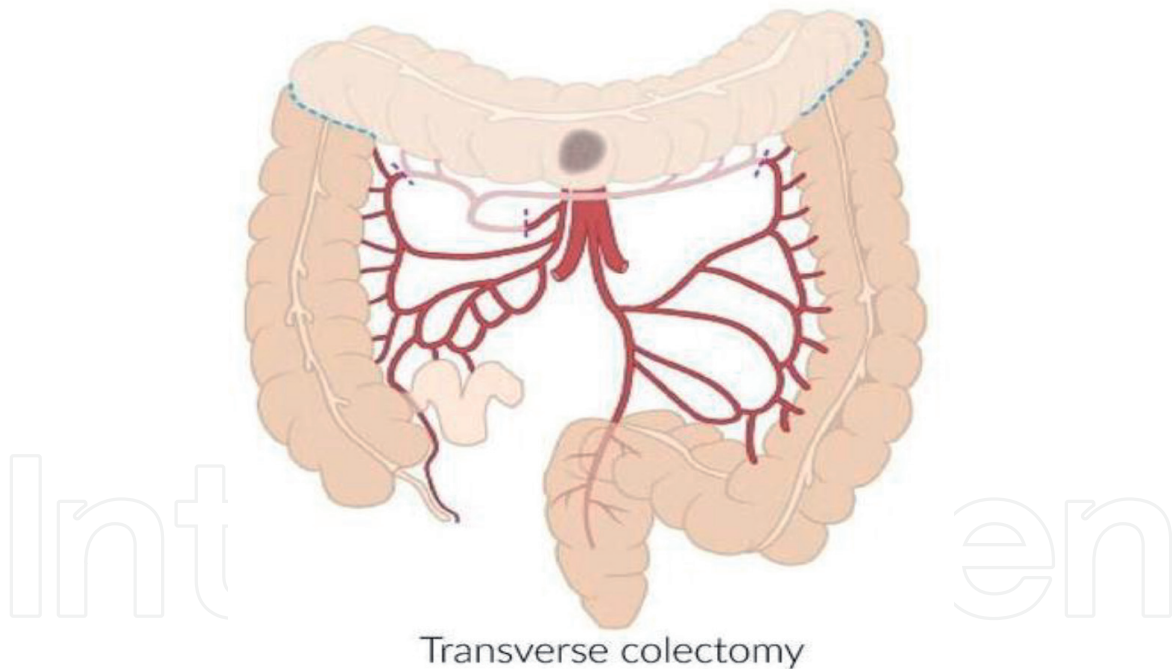
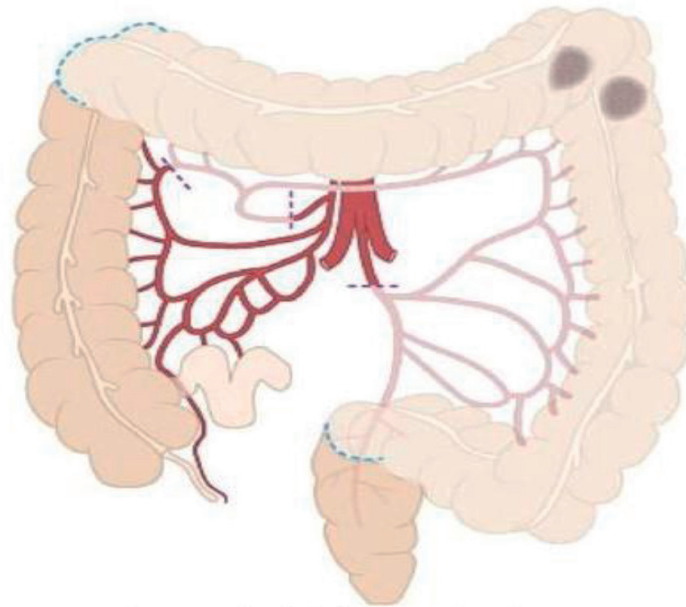


Figure 3.
D2/3 transverse colectomy.

and ascending branches of the left colic vessels, extended gastrocolic lymphadenectomy and colo colic anastomosis TT, or extended right hemicolectomy with omentectomy, mesocolon excision and extended gastro-colic lymphadenectomy, prepancreatic lymphadenectomy followed by an ileocolic end to end anastomosis (**Figure 4**) [28, 29].

The principle of diversion or the protection of an anastomosis using an ileostomy [28] has lost ground lately, being today only an exceptional indication [33].

In certain particular situations, like in an emergency, it is useful to practice a subtotal colectomy (**Figure 5**), as radical as possible with ileo sigmoid anastomosis.



Extended left hemicolectomy

Figure 4.
D2/3 extended left hemicolectomy.

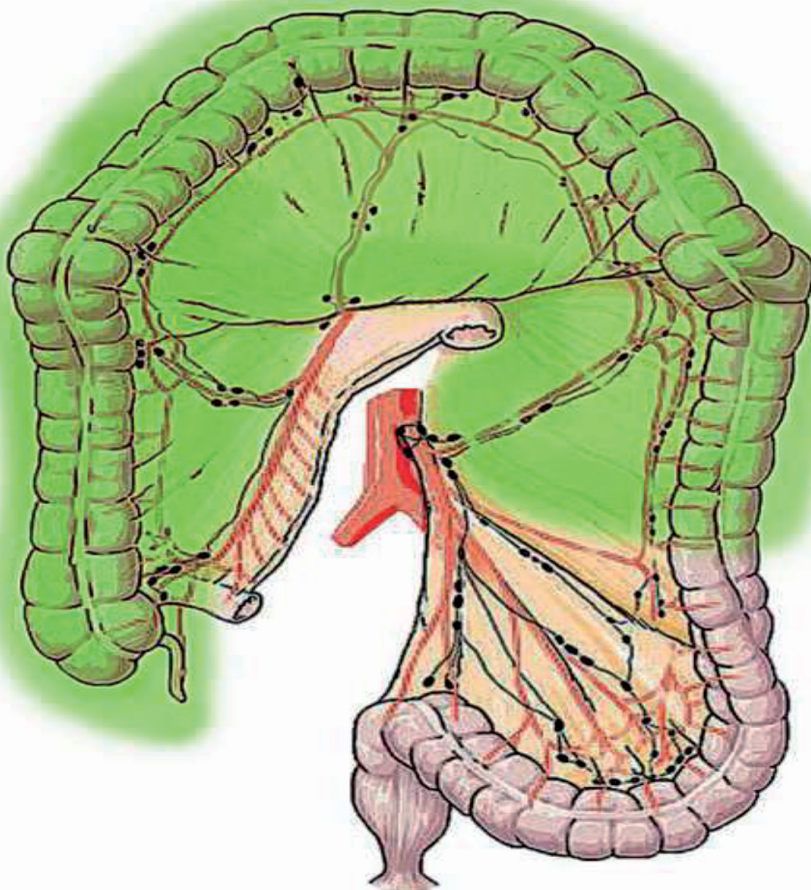


Figure 5.
D2/3 subtotal hemicolectomy.

The second indication for subtotal colectomy is the cecal diastatic perforation with the occlusive tumor in the transverse colon and the third indication for subtotal colectomy is synchronous tumors.

Extended right hemicolectomy is performed, in an emergency in about 73.7% of cases while left hemicolectomy is performed in 20% [2].

4.2 Tumor perforation with the peritoneal syndrome

Perforation followed by localized or generalized peritonitis is the second most common cause of complications in transverse colon cancer [3, 28].

Due to generalized peritonitis, septic shock, and multiple organ failure (MSOF), the patient becomes hemodynamically and respiratory unstable, leading to post-operative management governed by other principles, namely hydro electrolytic rebalancing and stabilization, exploratory laparotomy, identification of exact perforation site, and rapid surgical gestures.

Perforations in this situation are frequently diastatic and the most frequent localization is in the cecum region. In this situation, subtotal colectomy is required, followed by ileosigmoid anastomosis. In some rare cases, there is the possibility of parietal perforation through tumor necrosis and localized peritonitis, which prolongs the patient's addressability to the doctor. This situation is more common with the transverse colon or splenic flexure. However as long as the general condition of the patient is stable, a limited resection such as transversectomy can be attempted, but with the establishment of a diversion colostomy or by emptying the colon on the operating table with a first intent digestive anastomosis being recommended especially by Asian authors [28].

The hemorrhagic syndrome represents the 3rd emergency form of transverse colon cancer, the rarest form being an uncompensated hypovolemic shock with hemodynamic instability [28].

The presence of hemorrhage in cancer pathology is common in about 50% of cases [28]. The general form of manifestation, however, is occult hemorrhage, with minimal blood loss that does not suddenly undermine the patient. Thus, exsanguinating shock is rare [3].

If the endoscopic intervention cannot stop the hemorrhage or if embolization is not successful, then resection surgery is required when more than 6 units of blood [31] are transfused, followed by either a double colostomy or an anastomosis depending on the patient's hemodynamic stability [3, 28].

5. Discussions

The localization of the primary tumor in the transverse colon and the type of the emergency: occlusion, peritonitis with diastatic perforation or hemorrhage, as well as hemodynamic and respiratory stability of the patient, severity of hydroelectrolytic imbalance, require as emergency surgical treatment the following surgical therapeutic options (on cases that may benefit from surgical treatment):

- In the case of the unstable patient, performing a lateral (loop) or terminal colostomy or ileostomy, possibly associated with a segmental resection for an area of perforation or hemorrhage and the second surgery for curative resection with associated D2/3 lymphadenectomy and anastomosis.
- In the case of the stable patient, the intention will be curative surgical treatment and here an intervention with D2/3 lymphadenectomy and mesocolon resection is required according to the rule – CME and CVL imposed by Hohenberger. Depending on the location of the tumor hepatic flexure,

standard transverse colon or splenic flexure, the presence of another synchronous tumor formation, vascular abnormalities or anatomical features of the transverse colon, high localization of the splenic flexure, the technical variants that can be achieved are represented by: segmental colectomy of the transverse colon or transversectomy, extended right colectomy, subtotal colectomy with CME and CVL Hohenberger and per-primal anastomosis TT, LL or LT, depending on local factors, technical possibilities – manual or mechanical and experience or preference of the surgeon.

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