



Original Article

Vascular Anatomical Considerations and Its Relevance in Colon-Sigmoid and Rectal Surgery for Cancer: Personal Experience

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Abstract

The ideal level of ligation of the inferior mesenteric artery (IMA) during curative resection of sigmoid and rectal cancer is still controversial. The aim of this retrospective review was to examine the impact of selective arterial ligation in relation not only to the vascular respect of the bowel but also the reduction of anastomotic leak in patients undergoing surgery for colon rectal cancer with IMA preservation.

Patients and Methods: We performed a cohort of 127 laparoscopic colosigmoid and rectal resections for cancer from January 2016 to December 2022 at Casa di Cura Bernardini Clinic. All patients underwent total colonoscopy with tattooing of the tumor. CT scan total body was performed with arteriographic study of the arterial vascular anatomy of IMA and its branches. 121 patients (95,2%) underwent laparoscopic procedure, 6 (4,7%) were converted to open surgery for adhesion syndrome and haemorrhage.

Results: Before hospital discharge, which took place on average after 8 days, all patients underwent radiological control of the anastomosis. Only one patient had an anastomotic laceration due to malfunction of the circular stapler during extraction. No patient presented clinical and/or radiological signs of anastomotic leak. There were no reports of postoperative death up to one month after surgery.

Conclusion: Low ligation of IMA during curative resection of sigmoid colon and rectal cancer appears to be associated with lower risk of anastomotic leakage and overall morbidity. Furthermore, the low ligation with preservation of left colic artery had similar lymph node yield although technically more demanding.

Key words: Inferior mesenteric artery, Left colic artery colon rectal cancer, Laparoscopic

Introduction

The left colon carcinoma represents a technical challenge for the colorectal surgeons both for the difficulty of the anatomical location and dissection from the surrounding organs such as spleen, tail of the pancreas, duodenojejunal flexure, but also for the reconstruction and the vascular anatomy of the remain colon specially if an extended left colectomy is performed. An effective surgical technique derives from a good knowledge of anatomy and a good result cannot be separated from the experience that each of us has gained in terms of success but above all complications we have had over the years. In laparoscopic radical resection for rectal cancer, high tie (HT) of the inferior mesenteric artery (IMA) at its origin is essential for in bloc lymphadenectomy. Some Authors have demonstrated the clinical significance of lymph node dissection from the origin of the IMA for postoperative staging and prognosis [1]. However, HT at the origin of the IMA may lead to postoperative poor anastomotic perfusion, which increases the incidence of anastomotic leakage (AL) [2]. Many surgeons prefer a

low-tie (LT) technique, which ligates the IMA while preserving the left colic artery (LCA) after lymph nodes around the IMA were dissected [3], after all, the surgeons themselves consider non-preservation of LCA as the IMA ligation 2 cm from the aortic origin. The LCA non-preservation has the advantage of lower anastomosis traction, more lymphatic clearance oncological benefits, and the disadvantage of the risk of poor blood supply of the anastomosis and autonomic nerve damage around the origin of the IMA [4].

In most cases, sigmoid resection is associated with an acceptable morbidity rate. Although anastomotic leak is the most feared complication, in the last decade a growing attention has been dedicated to the functional outcomes genitourinary and bowel function above all and quality of life (QoL). Although certain complications may be related to the patient's general conditions, QoL and functional outcomes are mostly associated with the surgical technique. Therefore, several technical modifications have

been proposed and between these the IMA preservation is an attempt to reduce the anastomotic leak that we consider the most serious complication.

The aim of this systematic review is to describe safe and feasibility of laparoscopic left-colectomy, sigmoid resection and anterior rectal resection in relation not only to the vascular respect of the bowel but also the quantitative and qualitative reduction of anastomotic leak in patients undergoing surgery for colon-rectum cancer with IMA preservation.

Materials and Methods

From January 2016 to December 2022, we were collected the data of 127 patients undergoing left colon-rectal resection for cancer in our Institution Bernardini Clinic in Taranto Italy. All patients were operated on by the same operating team. Preoperative data included: gender, age, ASA grade, type of hospitalization (elective or emergency), previous surgery, the site of cancer with "tattoo" during colonoscopy, time of operation, hospital stay, postoperative complications. All patients underwent total body CT-scan with arterial vascular study of the left colon for correct mapping of the arterial network. The operation was performed laparoscopically in 121 patients (95,2%) while 6 of them (4,7%) were converted to the open technique, 5 (3,9%) for adhesion syndrome and 1 (0,7%) for hemorrhage during surgery. The site of the tumor was the left colonic angle in 2 patients (1,5%), the descending colon in 9 patients (7,2%), the sigmoid colon in 33 patients (25,0%), the rectum 83 patients (65,4%). During the operation all patients were placed in lithotomy position, and we placed 4 ports including the optical port, precisely 10 mm trocar in the umbilicus as the optical port, 5 mm trocar in right hypochondrium, one 10 mm trocar in right iliac fossa and one 5 mm trocar in left iliac fossa. We made pneumo-peritoneum and maintained abdominal pressure at 12 mmHg. The dissections were performed using laparoscopic ultrasound knife.

Surgical treatment

The mobilization of the splenic flexure is not always necessary, but we are convinced that it is mandatory for a tension-free anastomosis. The patient is in maximal reverse Trendelenburg positioning and rotated to the right in order to retract the greater omentum which is brought over the stomach and the transverse colon upward. Thus identifies the first jejuna loop with the ligament of Treitz and the inferior margin of the pancreas which allows to identify the inferior mesenteric vein (IMV). This maneuver allows the dissection between the Toldt fascia anteriorly and Gerota fascia posteriorly. The descending colon mobilization will be completed.

For tumors localized to the splenic flexure (2 patients) and the descending colon (9 patients), we dissected the LCA at the origin, preserving the sigmoid arteries (SA). The IMV was divided at the inferior border of the pancreas. The colon dissected 10 cm proximal and distal to the tumor. The anastomosis was performed end-to-end or side-to-side with a stapler. Lymph nodes dissection provided for the removal of 231, 232 groups for tumor of the splenic angle, while for descending colon the lymph nodes of 241 and 242 group were also removed. For tumors in the sigmoid colon (33patients) we divided the corresponding SA at the origin preserving the LCA and superior rectal artery (SRA). The IMV was divided close to the LCA, and the colon was dissected 10 cm from proximally and distally to the tumor. The lymphadenectomy was performed for 241 and 242 groups with extension to 251 and 252 groups for cancer located at the rectosigmoid junction. For localizations to the rectosigmoid junction (21 patients) or intraperitoneal rectal cancer (62 patients) the SRA was dissected below the origin of the LCA which is preserved while the IMV is divided close to the LCA. The colon is dissected 10 cm proximally to the tumor and 5 cm distally to it. The lymphadenectomy is completely similar to the previous one with an extension to 253 group for rectal cancer. The anastomosis was performed with a transanal mechanical stapler.

Results

Between January 2016 and December 2022, 127 patients with colorectal cancer were included in this retrospective study. The baseline characteristics of the group are shown in Table 1. The surgical data and the related postoperative complications are shown in Table 2. Before their hospital discharge, all patients underwent radiological examination with barium enema on seventh day to confirm the absence of anastomotic leak even minimal. For 3 patients (2,3%) an ileostomy was made because the colorectal anastomosis was performed at 3-4 cm from the anal verge. The patients were re-canalized after 3 weeks following radiological control of the anastomosis. In 4 patients (3,1%) a "ghost ileostomy" was performed and removed after 7 days always after radiological control of the anastomosis. Only one patient had complete laceration of anastomosis due to a malfunction of the stapler during its extraction through the anus. This complication induced to perform a terminal colostomy still accepted by patient. The incidence of metastasis to station 253 nodes was 2,3% (3 of 127). The postoperative complications include anastomotic bleeding in two cases (1,5%) and tenesmus in one patient (0,7%) resolved spontaneously after two weeks. Median hospital stay was 8 days and there were no deaths reported within 30 days of surgery.

Table 1: Demographic Data of patients

Variables	
Gender F/M	48/79
Age	58.6+-8.9
Type of hospitalisation/Election/ Emergency	127/0
ASA 1	2 (1.5%)
ASA 2	72 (56.7%)
ASA 3	53 (41.8%)
Time of surgery	168.7+-31.6
Previous abdominal surgery	12 (9.5%)
Postoperative hospitalized days	7+-1.2

Table 2: Surgical data of patients

Surgical Data	Percentage
Ghost ileostomy	N =4 /127 (3.1%)
Ileostomy	N= 3/127 (2.3%)
Complete laceration of anastomosis	N 1/127 (0.8%)
Anastomotic bleeding	N = 2/127 (1.6%)
Tenesmus	N 1/127 (0.8%)
Adverse events	1 (0.7%)
Anastomotic leakage	0

Discussion

In colorectal cancer (CRC) surgery, AL is the most common serious post-operative complication and an important cause of mortality. It is still not certain whether high or low ligation of IMA is better for reducing the risk of AL. In considering that Seike et al. [5] found the colonic blood flow to vastly decrease after ligation of IMA with the subsequent conclusion that this could be an unavoidable factor in the pathophysiology of colorectal anastomotic leakage, therefore it can be understood that a well vascularized anastomosis reduces the risk of leaks. Starting from this principle we have adept a selective arterial ligation according to the modalities exhibited in the paragraph of surgical treatment.

High ligation of IMA is often indispensable to achieve a tension-free anas-

tomosis during low anterior resection, and undoubtedly, blood supply is a crucial factor for the healing of colorectal anastomosis. Some surgeons believe that the marginal arteries are sufficient to guarantee adequate blood supply to the anastomosis in patients receiving high ligation of IMA [6], whereas others argue that LCA ligation would reduce blood supply to the proximal limb [7, 8].

With the division of the IMA at its origin, the blood supply to the left colon depends on the blood flow from the superior mesenteric artery (SMA) via the middle colic artery supplying the marginal artery of Drummond and the arc of Riolo which may be missing in up to 4% to 20% of patients [9]. In these patients left colectomy is dependent on the IMA for blood supply, and the high-ligation technique can possibly cause ischemic changes in the anastomosis. Therefore, it is mandatory to preserve the LCA in order to maintain blood supply.

Another debate to evaluate is whether the low ligation (LL) can result in a complete lymphadenectomy at the root of IMA because the lymph node dissection is the key to radical resection and accurate tumor staging colorectal cancer. A study [10], showed that patients with stage T1 rectal cancer had no metastasis in group 253 lymph nodes, while the metastasis rate was 0,95% in stage T2, 5,22% in stage T3, and 6,12% in stage T4, suggesting that metastasis in group 253 lymph nodes might theoretically exist in all rectal cancers above stage T2. Therefore, if the group 253 lymph nodes can be removed is the key to the preservation of the LCA procedure and the main point of controversy regarding the preservation of LCA. However, our experience indicated that selective arterial ligation is not the only way to eradicate apical lymph nodes and the IMA sheath. In our experience, we dissected the IMA sheath and the adipose tissue with lymph nodes the triangular area of the aorta. As our results show, the number of harvested lymph nodes was 16.8, therefore there is no contradiction between LCA preservation and apical lymph nodes dissection. Must be recognized that laparoscopic dissection of lymph nodes with preservation of LCA is technically demanding and the operation time longer but with satisfactory results.

The incidence of AL after anterior resection (AR) varies from 3%-26% [11-13], and postoperative mortality rate 6%-9% [14]. The most two important factors in preventing AL are to ensure the anastomosis is tension-free and has a sufficient blood supply. On the one hand, the risk of poor blood supply of the anastomosis could outweigh the oncological benefits of performing high ligation of IMA is found to be associated with acceptable anastomotic leak rate. There is an increased risk of poor colonic stump blood supply when relying on the marginal artery alone, therefore, if this artery is not adequate, a more extended intestinal resection has to be performed, even if it is oncologically unnecessary.

In conclusion, our findings of a retrospective analysis of a cohort of 127 patient with left colon and rectal cancer who underwent laparoscopic anterior resection affirm that LT of IMA with preservation of LCA maintains the oncological principle for lymph nodes dissection around and at the root of the IMA and had improved short-term outcome of less AL possibly due to better preservation of blood supply.

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Conflict of interest statement: All authors declare there are no competing interests in this study.

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