Al-Azhar International Medical Journal

Volume 5 | Issue 4 Article 56

4-30-2024

Section: Onco-surgery

Guided Preservation of left Colic Artery During Laparoscopic Resection of Left Sided Colorectal Malignancy

Mohamed Essmat Abd El Ghany
Surgical Oncology, Faculty of Medicine for boys, Al-Azhar University, Cairo, Egypt

Ahmed Shoukry Hafez
Surgical Oncology, Al-Salam Oncology Center, Cairo, Egypt

Mohamed Mamdouh Ahmed
Surgical Oncology, Faculty of Medicine for boys, Al-Azhar University, Cairo, Egypt

Mohamed Hossam Mohamed Abd El Aziz
Surgical Oncology, Faculty of Medicine for boys, Al-Azhar University, Cairo, Egypt, mohamedhossam303@gmail.com

How to Cite This Article

Abd El Ghany, Mohamed Essmat; Hafez, Ahmed Shoukry; Ahmed, Mohamed Mamdouh; and Abd El Aziz, Mohamed Hossam Mohamed (2024) "Guided Preservation of left Colic Artery During Laparoscopic Resection of Left Sided Colorectal Malignancy," *Al-Azhar International Medical Journal*: Vol. 5: Iss. 4, Article 56.
DOI: https://doi.org/10.58675/2682-339X.2400

ORIGINAL ARTICLE

Guided Preservation of left Colic Artery During Laparoscopic Resection of Left Sided Colorectal Malignancy

Mohamed E. Abd El Ghany [a] , Ahmed S. Hafez [b], Mohamed M. Ahmed [a], Mohamed H. Mohamed [a,*]

[a] Department of Surgical Oncology, Faculty of Medicine for boys, Al-Azhar University, Cairo, Egypt
[a] Department of Surgical Oncology, Al-Salam Oncology Center, Cairo, Egypt

Abstract

Background: ***In the world, colorectal cancer (CRC) is the cancer that is most likely to be diagnosed and the third largest cause of cancer-related mortality. Surgery is still the major treatment for colorectal cancer (CRC).***

Objective: ***Before surgery, CT mesenteric angiography and intraoperative ICG were used to assess the sufficiency of vascular perfusion of the residual colon following left colic artery sparing to lower the risk of anastomotic leakage and maintain the same oncological outcomes.***

Patients and Methods: ***A prospective research of patients treated between December 2021 and October 2023 at the surgical oncology department of Al-Azhar University and Al Salam Oncology Center, MOH, Egypt, for rectal and sigmoid colon cancer, using TME and sigmoid colectomy with CME.***

Results: ***Due to tension-free anastomosis, the percentage of patients with CME in the LL group was significantly higher than in the HL group (30% & 0%, respectively), according to an analysis of the surgical specimens from both groups. Contrarily, there was a highly significant difference in the percentage of patients with TME in the HL group compared to LL (100% & 70%).***

Conclusion: ***Further studies should be done as the long-term oncological outcome should be handled with more concentration. Reporting and sharing knowledge about the value of left colic artery preservation and use of intraoperative use of ICG for assessment of colorectal anastomosis to improve the overall results.***

Keywords: Colorectal cancer; total mesorectal excision; disease-free survival

1. Introduction

The third most prevalent type of cancer diagnosed worldwide and the third largest cause of cancer-related mortality is colorectal cancer (CRC). The mainstay of treatment for colorectal cancer is still surgery, which involves removing the tumour in its entirety along with the surrounding bowel and lymph nodes along the vessels. This is primarily accomplished through total mesocolic (TMC) and total mesorectal excision (TME) procedures, which improve patients' overall survival (OS) and disease-free survival (DFS).[1]

Regarding the inferior mesenteric artery (IMA) ligation site during TME, there are two competing schools of thought: low ligation (LL) and high ligation (HL). IMA root lymph node dissection has received more attention due to technical advancements. The optimal IMA ligation level and whether or not to clear the 253 lymph nodes are not well-documented decisions.[2]

Accepted 14 April 2024.
Available online 30 April 2024

* Corresponding author at: Surgical Oncology, Faculty of Medicine for boys, Al-Azhar University, Cairo, Egypt.
E-mail address: Mohamedhossam303@gmail.com (M. H. Mohamed).

https://doi.org/10.58675/2682-339X.2400

High IMA ligation is advised by certain researchers, who claim that this procedure improves node harvest and allows for more drastic lymph node resection. On the other hand, a theory suggests that cutting off blood supply to the distal colon could raise the danger of anastomotic leakage (AL) and cause the autonomic nerves near the IMA's origin to die. On the other hand, the colon's proximal anastomotic stoma receives an adequate blood flow thanks to the low IMA ligation approach. Moreover, there is minimal to no chance of autonomic nerve damage when using this method; nevertheless, the node clearing may be a little less drastic.[3]

Surgeons typically assess intestinal perfusion using several clinical indicators; examples of observable signs include the hue of the colon, detectable pulse, rhythmic contractions, and visible bleeding from the outermost blood vessels. Even very skilled surgeons may misread these indicators due to their subjectivity. The most promising technique for assessing intestinal perfusion in real-time and reducing acute lung injuries (ALs) in recent years has been NIR (near-infrared) fluorescence technology using indocyanine green.[4]

Before surgery, CT mesenteric angiography and intraoperative ICG are used in this study to assess the adequacy of vessel perfusion of the remaining colon following left colic artery sparing while on laparoscopic resection of left-sided cancer of the colorectal to lower the risk of leakage and provide the same oncological results.

2. Patients and methods

A prospective study of the patients with rectal and sigmoid colon cancer who underwent TME and sigmoid colectomy with CME in the period from December 2021 till October 2023 in surgical Oncology Department, Al-Azhar University and Al Salam Oncology Center, MOH, Egypt.

Inclusion criteria: cases of rectal or sigmoid cancer that do not have further intestinal invasion or distant metastases. Patients who can tolerate the procedure and are classified as I–III by the ASA.

Exclusion criteria: Emergency operations, Metastatic colon cancer & patients with low rectal tumors that necessitate abdominoperineal resection. Patients with synchronous lesions in a part of the colon other than sigmoid or rectum. Patients who are medically unfit for surgery.

Primary outcome: To evaluate the disparity in the risk of anastomotic leakage between the ligation of the inferior mesenteric artery at a high level and at a low level..

Secondary outcomes: Pathologic and immediate clinical results, such as the quantity of lymph nodes (LNs) removed, the method (HL & LL), the length of time, the specimen's quality, blood loss, and hospital stay.

Preoperative workup: carcinoembryonic antigen (CEA). C.T. abdomen and pelvis to demonstrate regional tumor extension, MRI pelvis with rectal protocol to assess perirectal tissue invasion. C.T. mesenteric angiography for localization of arc of riolan and IMA branches.

Main operative technique: Following the elevation of the rectosigmoid junction, the peritoneum was dissected at the sacral promontory level, extending the inferior mesenteric arteries from the retroperitoneum. The precise avascular plane, which is positioned just beneath the artery to safeguard autonomic nerves and keep it away from the ureter and gonadal veins, is opened cranially all the way to the origin of the inferior mesenteric artery and caudally up to the sacral promontory.

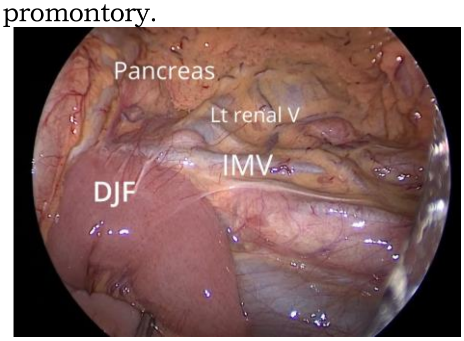

Figure 1. Location of IMV in close relation to DJF and inferior border of pancreas.

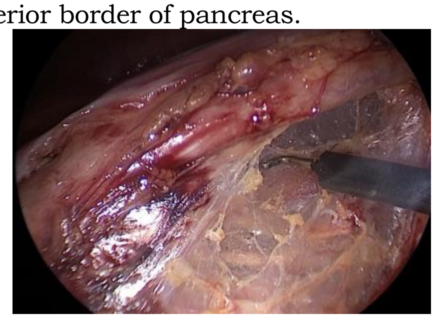

Figure 2. Plane of dissection just beneath the inferior mesenteric artery with preservation of retroperitoneum.

At such a plane, blunt dissection began, extracting the artery from the retroperitoneum in a lateral orientation. In cases of low constriction (left colic artery preservation), dissection of lymph nodes and inferior mesenteric artery exposure occur; in cases of high ligation, inferior mesenteric artery ligation occurs.

The inferior mesenteric vein is then clipped at the level of the inferior border of the pancreas, allowing extra length of the proximal stump. Next, the dissection is continued in a cranial direction, separating the colonic mesentery from the anterior surface of Gerota's fascia toward the spleen laterally and inferior pancreatic border superiorly.

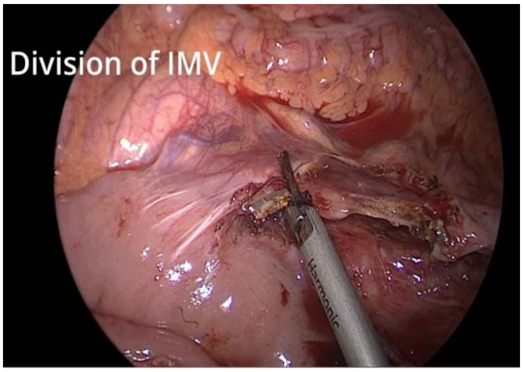

Figure 3. IMV division at the pancreatic inferior border and DJF level.

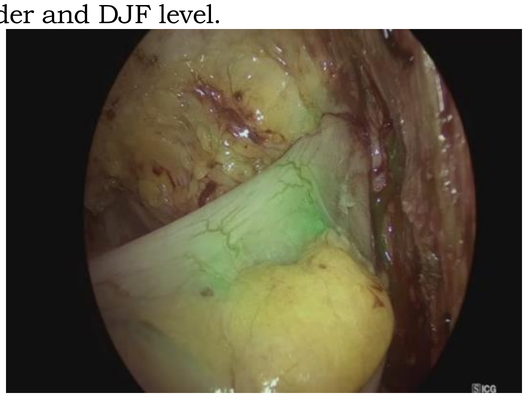

Figure 4. ICG post anastomosis.

To begin the rectal the mobilization at the posterior side of the mesorectum in the without blood vessels plane toward the pelvic floor while preserving the hypogastric plexus, the rectosigmoid junction was raised out of the pelvis. In cases of low anterior resection, the rectum was divided with a stapler in order to prepare the proximal stump. When performing sigmoid colectomy, partial mesorectal excision was carried out. When there was no sphincter infiltration and the tumor was extremely low, intersphincteric excision was used. The specimen was taken through the anal canal, and coloanal anastomosis was then sewn by hand. To evaluate the vascularity of the anastomosis, indocyanine green was injected. Diversion loop ileostomy was subsequently carried out in all intersphincteric resection cases as well as post-neoadjuvent rectal cancer cases.

Figure 5. Specimen after extraction, donut and lymph nodes.

Post-operative morbidity: Any additional variation from the typical post-operative course was classified as post-operative morbidity and evaluated using the Clavien-Dindo grading system.[5]

Statistical Analysis

The data was entered, edited, and reviewed using Version 23 of the IBM SPSS Statistics Package. Non-parametric quantitative data were reported as the median and interquartile range (IQR), while parametric results were presented as the mean, standard deviations, and ranges. Quantitative factors were represented both in the form of percentages and numerical values. The Chi-square test was employed to compare groups based on categorical data. The Independent t-test was employed to compare two groups using numerical data and a distribution that follows a parametric assumption. The Mann-Whitney test was used to compare two groups based on quantitative data following a non-parametric distribution. The acceptable tolerance for error was established at 5%, while the confidence level was established at 95%. Therefore, the subsequent p-value was considered significant: Inconclusive if $P > 0.05$. The value of P is less than 0.05, indicating statistical significance. The probability (P) is less than 0.01. Significant.

3. Results

Table 1. Percentage of patients with postoperative anastomotic leakage

POSTOPERATIVE ANASTOMOTIC LEAKAGE	NO. = 45
NO	42 (93.3%)
YES	3 (6.7%)

This table showed that postoperative anastomotic leakage was occurred in 3 patients & were managed conservatively.

Table 2. Quality of specimen among the studied patients.

QUALITY OF SPECIMEN	TOTAL NO. = 50
COMPLETE MESOCOLOIC EXCISION	6 (12.0%)
TOTAL MESORECTAL EXICISION	44 (88.0%)

This table shows the quality of specimen of studied patient based on intact peritoneal covering and central vascular ligation.

Table 3. Comparison between high tie of IMA and left colic artery preserved (low tie) regarding pre-operative imaging study, procedure and need of ICG intra-operative.

		HIGH TIE OF IMA	LEFT COLIC ARTERY PRESERVED (LOW TIE)	TEST VALUE	P-VALUE	SIG.
		No, = 30	No. = 20			
PREOPERATIVE CT ANGIOGRAPHY	Not done	27 (90.0%)	13 (65.0%)	4.688*	0.030	S
	Done	3 (10.0%)	7 (35.0%)			
PREOPERATIVE CT ANGIOGRAPHY FINDING	No arc of riolan	5 (83.3%)	4 (100.0%)	0.741*	0.389	NS
	Arc of riolan	1 (16.7%)	0 (0.0%)			
DIAGNOSIS AND LOCATION OF TUMOR	Post neoadjuvent cancer rectum	30 (100.0%)	12 (60.0%)	14.286*	0.001	HS
	Rectosigmoid cancer	0 (0.0%)	6 (30.0%)			
	Cancer sigmoid	0 (0.0%)	2 (10.0%)			
PROCEDURE	Low ant. Resection with covering ileostomy	19 (63.3%)	16 (80.0%)	1.587*	0.208	NS
	Abdominperineal resection	3 (10.0%)	0 (0.0%)	2.128*	0.145	NS
	Intersphincteric resection with covering ileostomy	6 (20.0%)	0 (0.0%)	4.545*	0.033	S
	Sigmoid colectomy	0 (0.0%)	2 (10.0%)	3.125*	0.077	NS
	Low anterior resection	0 (0.0%)	2 (10.0%)	3.125*	0.077	NS
	Abdominperineal resection + With unilateral oophorectomy	1 (3.3%)	0 (0.0%)	0.680*	0.410	NS
	Abdominperineal resection + liver metastatectomy	1 (3.3%)	0 (0.0%)	0.680*	0.410	NS
INTRAOPERATIVE ICG	No	28 (93.3%)	4 (20.0%)	28.009*	0.000	HS
	Yes	2 (6.7%)	16 (80.0%)			

This table shows highly significant difference between both groups regarding location of tumour and need for ICG.

Table 4. Comparison between high tie of IMA and left colic artery preserved (low tie) regarding total count of LN and count of positive LN.

		HIGH TIE OF IMA	LEFT COLIC ARTERY PRESERVED (LOW TIE)	TEST VALUE	P-VALUE	SIG.
		No. = 30	No. = 20			
TOTAL LN	Mean ± SD	16.63 ± 2.51	16.25 ± 3.8	0.430•	0.669	NS
	Range	12 – 20	12 – 24			
POSITIVE LN	Median (IQR)	0 (0 – 1)	0 (0 – 0)	-1.480≠	0.139	NS
	Range	0 – 13	0 – 1			

This table shows no significant difference regarding harvested LN in both groups.

Table 5. Comparison between high tie of IMA and left colic artery preserved (low tie) regarding incidence of postoperative anastomotic leakage

POSTOPERATIVE ANASTOMOTIC LEAKAGE	HIGH TIE OF IMA	LEFT COLIC ARTERY PRESERVED (LOW TIE)	TEST VALUE	P-VALUE	SIG.
	No. = 25	No. = 20			
NO	23 (92.0%)	19 (95.0%)	0.161*	0.688	NS
YES	2 (8.0%)	1 (5.0%)			

This table shows no significant difference in risk of AL.

Table 6. Comparison between high tie of IMA and left colic artery preserved (low tie) regarding time of operation, T stage, N stage, hospital stay and CEA.

		HIGH TIE OF IMA	LEFT COLIC ARTERY PRESERVED (LOW TIE)	TEST VALUE	P-VALUE
		No. = 30	No. = 20		
TIME OF OPERATION (MIN.)	Median (IQR)	197.5 (190 – 214)	220 (202.5 – 231.5)	-2.761≠	0.006
	Range	180 – 240	180 – 240		
T STAGE	T0	0 (0.0%)	10 (50.0%)	20.673*	0.000
	T1	4 (13.3%)	0 (0.0%)		
	T2	6 (20.0%)	2 (10.0%)		
	T3	18 (60.0%)	8 (40.0%)		
	T4b	2 (6.7%)	0 (0.0%)		
N STAGE	N0	22 (73.3%)	18 (90.0%)	2.500*	0.287
	N1	6 (20.0%)	2 (10.0%)		
	N2b	2 (6.7%)	0 (0.0%)		
HOSPITAL STAY	Median (IQR)	7 (7 – 9)	8 (7 – 8)	-1.028≠	0.304
	Range	6 – 14	7 – 14		
CEA	Median (IQR)	15.5 (10.4 – 25.5)	15 (7.45 – 23)	-0.916≠	0.360
	Range	2.5 – 28.5	2.5 – 26.5		

This table shows longer time operation in LL group.

4. Discussion

The conventional therapy for colorectal cancer involves performing radical surgery with curative intent to remove both the main malignancy and the draining lymph nodes. High ligation refers to ligating the inferior mesenteric artery (IMA) at its root. In contrast, low ligation involves ligating the artery distally to the bifurcation of the left side colic artery.[6]

Certain surgeons consider high ligation of the inferior mesenteric artery (IMA) essential when doing an extensive lymph node dissection. This is because high ligation improves tumour staging accuracy and leads to superior oncological results. High ligation of the inferior mesenteric artery (IMA) is a more direct and efficient procedure that enables optimal movement of the residual left colon, preventing strain in the anastomosis. Nevertheless, the ligation of the inferior mesenteric artery (IMA) has two drawbacks. The remaining segment of the colon only receives blood from the superior mesenteric artery, resulting in a reduced blood supply in the marginal artery. Consequently, the blood flow to the connection of blood vessels may be inadequate, particularly in individuals with arteriosclerosis. Furthermore, the act of dissecting the root of the inferior mesenteric artery (IMA) has the potential to harm the superior hypogastric plexus, leading to malfunction in the genitourinary system.[7]

In contrast, low ligation entails carefully separating tissues around the inferior mesenteric artery (IMA) while keeping the left colic artery intact. However, this procedure necessitates more time for dissection to provide sufficient blood flow to the distal colon. Multiple randomized controlled trials have been conducted to examine the efficacy of low and high ligation of the inferior mesenteric artery (IMA) to ascertain which procedure yields better results for patients with colorectal cancer (CRC). Matsuda et al. No significant disparity in cancer-related outcomes was found when comparing the two methods, but the incidence of anastomotic leaking was not assessed.[3]

This study aimed to address the dilemma of whether to perform high or low ligation of the inferior mesenteric artery. This was achieved using preoperative CT angiography to visualize the blood vessels in the rectosigmoid region and intraoperative indocyanine green to guide the preservation of the left colic artery. The goal was to ensure sufficient blood supply to the distal colon after resection to reduce the risk of anastomotic leakage and achieve similar oncological outcomes. Due to the limited trial duration, we could not collect data on the long-term oncological outcome. Therefore, we compared the pathological findings of our investigation with existing literature to get insight into the probable oncological outcome.

In this study, laparoscopic radical resection was performed on 50 patients with sigmoid and rectal cancer. Of these instances, 30 patients underwent high ligation, while the remaining 20 underwent left colic artery preservation. The decision for each procedure was based on preoperative CT findings with intraoperative indocyanine green localization. The results of our study revealed a highly significant disparity between the two groups regarding tumor location (p-value 0.001). However, there was no significant difference between both groups regarding the total number of lymph nodes affected and the percentage of positive lymph nodes. The p-values for these comparisons were 0.669 and 0.139, respectively.

There was no statistically significant distinction in post-operative anastomotic leakage between the two groups being studied, as indicated by a p-value of 0.688. There was only one occurrence of slight leaking after surgery in the low-tie group, while the high-tie group had two occurrences. Conservative management was employed for all cases, with five cases being removed from the comparison due to the requirement for permanent diversion. A statistically significant difference was observed between the two groups in operation duration, with a p-value of 0.006 suggesting that the low-tie group had a longer operation time.

A total of 214 individuals were randomly assigned to either the high-level (HL) group (n = 111) or the low-level (LL) group (n = 103). The surgical procedure resulted in decreased GU function in both groups. The LL group exhibited enhanced continence and reduced obstructive urinary symptoms, leading to an increased quality of life nine months after the surgery. The LL group exhibited superior sexual function compared to the HL group after nine months. The LL group exhibited significantly higher urinated volume, maximum urine flow, and flow time than the other group 1 and 9 months after the surgery ($P < 0.05$). The anastomotic leak rate did not differ between the high ligation group (8.1%) and the low ligation group (6.7%). No significant disparities were observed regarding bleeding, surgical durations, complications following surgery, and initial oncological results across the groups.[8]

In a study involving 490 individuals (245 in each group), the total rate of anastomosis leakage was 4.5%. Specifically, the high ligation group had a leakage rate of 5.7%, and the low ligation group had a leakage rate of 3.3%. Nevertheless, there was no statistically significant difference in the rate of anastomosis leakage among both low and high-ligation groups ($P=0.191$). Additionally, there were no notable distinctions between the two groups regarding operative parameters such as operative time, loss of blood, transfusion of blood, open conversion, second operation, bowel recovery post-operative, or length of hospital stay.[9]

Two hundred fifteen individuals (107 for high temperature and 108 for low temperature) underwent laparoscopic resection. The occurrence of leakage of anastomotic fluid (HT: LT %) did not exhibit any notable disparities for grade 2 or higher (11.2:9.3) and grade 3 or higher (2.8:4.6). There were no disparities seen in the duration of the surgical procedure (200:205 min), amount of blood lost (15:15 ml), quantity of lymph nodes dissected (22:20), and length of hospital stay after the operation (10:10 days). The occurrence of intestinal obstruction in HT was statistically significant (3.7% vs. 0%, $p = 0.043$). There were no notable disparities in overall survival rates (5-year: 91.3% vs. 90.2%, $p = 0.850$) and free of disease (5-year: 83.2% vs. 78.0%, $p = 0.525$). No disparities were observed in the initial site of recurrence or cause of mortality between the two groups.[10]

Laparoscopic aided anterior resection was performed on 205 patients with rectal cancer; 126 of them were in the high occlusion group and 79 in the low ligation group. The median duration of the surgery was 173 minutes in the high ligation group and 180 minutes in the modified low ligation group ($p = 0.680$). The two groups' operating times did not differ noticeably from one another. Furthermore, the median intraoperative blood loss of the modified low ligation group's 50.0 ml (30.0-100.0 ml) and the high ligation group's 30 ml (30.0-50.0 ml) did not differ much. There were no statistically significant variations between the two groups' mean numbers of recovered lymph nodes per patient (16.4 in the high ligation group and 14.7 in the modified low ligation group). Anastomotic leaking did not differ significantly between the two groups; however, the high-ligation group only had two occurrences. The median duration between the operation and follow-up was 52 months (range 1-121 months). Between the high- and improved low-ligation groups, the 5-year overall survival rate was not substantially different (78.1 versus 87.7%, respectively; $P = 0.077$).[11]

5. *Conclusion*

Such subjects warrant more investigation since the long-term oncological result requires greater attention. Educating the colorectal community about the benefits of left colic artery preservation and the use of intraoperative ICG for assessing colorectal anastomosis will enhance overall outcomes and support surgeons in making informed decisions.

Disclosure

The authors have no financial interest to declare in relation to the content of this article.

Authorship

All authors have a substantial contribution to the article

Funding

No Funds : Yes

Conflicts of interest

There are no conflicts of interest.

References

1. Feng W, Zong Y, Zhao J, et al. High versus low ligation of the inferior mesenteric artery during laparoscopic rectal cancer surgery: A prospective study of surgical and oncological outcomes. J Surg Oncol. 2021;123 Suppl 1:S76-S80.
2. Hu S, Li S, Huang X, et al. The effect of different inferior mesenteric artery ligation levels and different lymph node dissection areas on the short- and long-term outcomes of rectal cancer. J Gastrointest Oncol. 2021;12(2):580-591.
3. Matsuda K, Yokoyama S, Hotta T, et al. Oncological Outcomes following Rectal Cancer Surgery with High or Low Ligation of the Inferior Mesenteric Artery. Gastrointest Tumors. 2017;4(1-2):45-52.
4. Kawada K, Hasegawa S, Wada T, et al. Evaluation of intestinal perfusion by ICG fluorescence imaging in laparoscopic colorectal surgery with DST anastomosis. Surg Endosc. 2017;31(3):1061-1069.
5. Dindo, D. The Clavien-Dindo classification of surgical complications. Treatment of postoperative complications after digestive surgery. 2014:13-7.
6. Draginov A, Chesney TR, Quereshy HA, Chadi SA, Quereshy FA. Association of high ligation versus low ligation of the inferior mesenteric artery on anastomotic leak, postoperative complications, and mortality after minimally invasive surgery for distal sigmoid and rectal cancer. Surg Endosc. 2020;34(10):4593-4600.
7. Campbell A, Macdonald A, Oliphant R, Russell D, Fogg QA. Neurovasculature of high and low tie ligation of the inferior mesenteric artery. Surg Radiol Anat. 2018;40(12):1343-1348.
8. Mari GM, Crippa J, Cocozza E, et al. Low Ligation of Inferior Mesenteric Artery in Laparoscopic Anterior Resection for Rectal Cancer Reduces Genitourinary Dysfunction: Results From a Randomized Controlled Trial (HIGHLOW Trial). Ann Surg. 2019;269(6):1018-1024.
9. Hsu CC, Hsu YJ, Chern YJ, et al. Potential short-term outcome advantage of low vs. high ligation of inferior mesenteric artery for sigmoid and rectal cancer: propensity score matching analysis. BMC Surg. 2023;23(1):33.
10. Fujii S, Ishibe A, Ota M, et al. Short-term and long-term results of a randomized study comparing high tie and low tie inferior mesenteric artery ligation in laparoscopic rectal anterior resection: subanalysis of the HTLT (High tie vs. low tie) study. Surg Endosc. 2019;33(4):1100-1110.
11. Zhang C, Chen L, Cui M, et al. Short- and long-term outcomes of rectal cancer patients with high or improved low ligation of the inferior mesenteric artery. Sci Rep. 2020;10(1):15339.