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Laparoscopic Left Hemicolectomy of Descending Colon Carcinoma with Superior Rectal Artery (SRA) Preservation and Natural Orifice Specimen Extraction (NOSE): A Standard Operating Procedure with a Video

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Abstract

Background: Laparoscopy-assisted radical resection of colorectal cancer and Natural Orifice Specimen Extraction Surgery (NOSES) are widely used worldwide. However, due to the low incidence of descending colon cancer, some problems remain in the application of laparoscopic and NOSES techniques in left hemicolectomy. Herein, we introduce the technical procedure of laparoscopic left hemicolectomy with Superior Rectal Artery (SRA) preservation and NOSE.

Methods: A retrospective analysis was performed on 39 patients who underwent laparoscopic left hemicolectomy with SRA preservation and NOSE in a single institution from November 2017 to May 2021. The patients' general information, preoperative data and short-term postoperative results were analyzed.

Results: All operations were completed smoothly, with an average operation duration of 227.17 ± 65.51 min, intraoperative bleeding of 91.05 ± 66.71 ml, time to ambulation of 11.97 ± 2.15 h, time to exhaust of 20.20 ± 10.08 h, time to liquid diet of 2.48 ± 0.72 days, and average postoperative stay of 7.66 ± 1.89 days. Two patients developed temporary intestinal obstruction, and one patient developed pulmonary infection. One patient developed a chyle fistula. One patient developed an intestinal infection. All of them recovered well after active supportive treatment and were discharged successfully.

Conclusion: Laparoscopic left hemicolectomy with SRA preservation and NOSE is safe and feasible, can achieve satisfactory short-term results, and is worthy of further clinical investigation.

Keywords: Laparoscopic left hemicolectomy; Descending colon; Natural Orifice Specimen Extraction (NOSE); Superior rectal artery

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Introduction

Globally, colorectal cancer is the third most common malignancy and the second most common cause of malignancy-related death. According to the GLOBOCAN project of the WHO Cancer Research Center, the number of new cases of colorectal cancer worldwide in 2020 was approximately 1.93 million, and the number of deaths could reach approximately 940,000 [1]. Colorectal cancer is closely related to socioeconomic level. The prevalence of Western lifestyles, changes in dietary patterns and reduction in physical activity have led to its continuous rise worldwide [2]. Laparoscopic technology has been gradually developed since the beginning of the 21st century. In the past 30 years, with the rapid development of laparoscopic technology and instruments, based on the principles of CME, TME principles and D3 radical tumor resection, laparoscopic-assisted radical resection of colorectal cancer has been introduced and is characterized by minimal trauma. This approach has the advantages of minimal pain and fast recovery and has been widely adopted around the world based on high-level clinical evidence [3-6].

Traditional minimally invasive surgery assisted by laparoscopy requires a small abdominal incision for specimen removal, which increases the incidence of incision infection, incisional hernia, and postoperative pain [7-10]. However, NOSES which is defined as removal of surgical specimen by opening a hollow viscus that already communicates with the outside world, such as the gastrointestinal tract or vagina [11], has obvious advantages in postoperative pain control, bowel function recovery, postoperative hospital stay, incision complications and cosmetic results because it does not require additional abdominal incisions [12,13].

Currently, NOSES has been satisfactorily used in laparoscopic radical resection of rectal cancer and has achieved good results. However, due to the low incidence of descending colon cancer, still some problems remain in the application of laparoscopic and NOSES techniques in left hemicolectomy regarding surgical route, blood vessel preservation, specimen removal technique, and intraluminal anastomosis. Therefore, we herein share this standardized operating procedure for performing laparoscopic and NOSES techniques in left hemicolectomy based on our single-center experience.

Materials and Methods

General materials

The clinical data of patients who underwent laparoscopic left hemicolectomy of descending colon cancer with NOSES and SRA preservation in the Gastrointestinal Surgery Department of Sichuan Cancer Hospital from November 2017 to May 2021 were collected retrospectively. In total, 39 patients were identified, including 20 males and 19 females. The average age was 59.97 ± 12.79 years, the average Body Mass Index (BMI) was 22.59 ± 2.64 kg/m^2, the average preoperative Carcinoembryonic Antigen (CEA) level was 2.73 ± 1.83 ng/ml, and the average maximum Circumferential Diameter (CDmax) of tumor was 3.52 ± 1.02 cm. According to the American Joint Committee on Cancer (AJCC) staging guidelines, 14 patients were stage I, 20 patients were stage II, and 5 patients were stage III. All patients were confirmed to have adenocarcinoma by pathological biopsy before the operation.

Surgical technique

Laparoscopic left hemicolectomy with SRA preservation and NOSE followed the principles of D3 dissection and CME. The surgical specimens were extracted through Transanal Specimen Extraction (TASE) for descending colon cancer. The intracorporeal end-to-end anastomosis was completed with a circular stapler.

Body position and trocar position: The patient was placed in the lithotomy position with the left side slightly elevated to facilitate easy maneuvering of the root of the Inferior Mesenteric Artery (IMA). The pneumoperitoneum and operation channel were established through five ports, as shown in Figure 1.

Operating around the IMA root (D3 lymph node dissection): The mesosigmoid was elevated to expose Toldt's space. The mesentery was opened at the root of the sigmoid colon through an intermediate approach, and the left Toldt's space was entered. The IMA root was approached not too close to the root but from the superior side of the IMA root to the bare area of the nerve in front of the abdominal aorta to better protect the Superior Hypogastric Plexus (SHP) and more completely clean the lymph nodes of the blood vessel root.

Superior rectal artery preservation: The key for anatomical dissociation of the Left Colonic Artery (LCA), Sigmoid Artery (SA) and SRA was to open the vascular sheath at the root of the IMA, sharply separate along the vascular sheath to the caudal side, and expose the LCA, SA and SRA. At the same time, the fat and lymphoid tissue around the artery were cleaned. Then, we could clearly see the branches of the IMA. The LCA and SA were ligated at the root of each branch with SRA preservation (Figure 2).

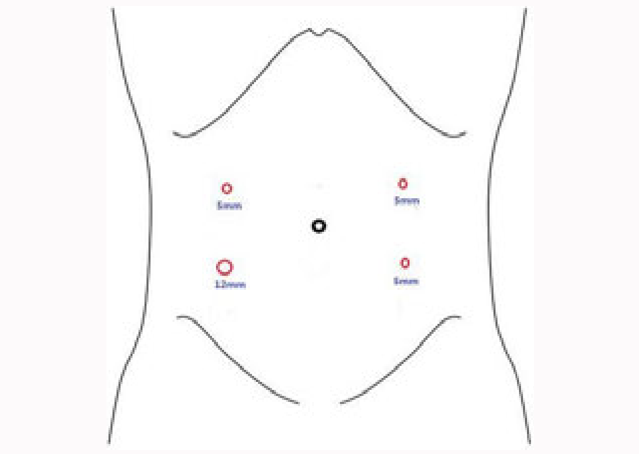

Figure 1: Trocar positions.

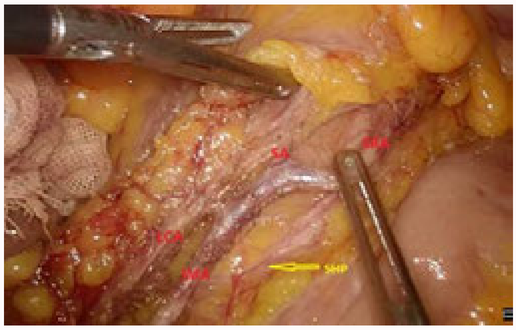

Figure 2: Superior rectal artery preservation.
LCA: Left Colonic Artery; IMA: Inferior Mesenteric Artery; SHP: Superior Hypogastric Plexus; SRA: Superior Rectal Artery; SA: Sigmoid Artery

Dissection of the mesorectum (CME procedure): According to the principle of CME, sharp dissection was performed to dissociate the descending colon. We dissociated the descending mesocolon along the medial side of the Inferior Mesenteric Vein (IMV), continuing to the lateral side until we observed Monk's line. The IMV was ligated at the inferior pancreatic edge, and dissection of the fascia was performed along this edge to the splenic flexure. Then, we changed the patient's position so that the head was elevated and the feet were lowered and began to dissociate the splenic flexure. The first step was to open the gastrocolic ligament along the gastroepiploic vessels. The dissection was extended to the splenic flexure, and then the Splenocolic ligament was disconnected. The second step was to disconnect the root of the left transverse mesocolon along the lower edge of the pancreas. The dissection was extended to the diaphragmatic colonic ligament, and then the splenic flexure was fully mobilized. After dissection of the lateral fascia of the descending colon, complete dissociation of the left hemicolon was performed (Figure 3).

Specimen extraction (NOSE): Transabdominal Specimen Extraction (TASE) was performed for descending cancer, with the following steps: (1) the mesocolon was dissected approximately 10 cm proximal and distal to the tumor, and the proximal and distal colon was dissected with an endoscopic liner stapler. (2) With the broken end protected by iodophor gauze, the sigmoid colon was opened. Then, a plastic bag was placed in the intestinal tube to avoid tumor implantation and intracorporeal contamination with bacteria. (3) A gastric tube was inserted from the anus, and the specimen was sutured to the gastric tube and removed transanally. (4) After the plastic bag

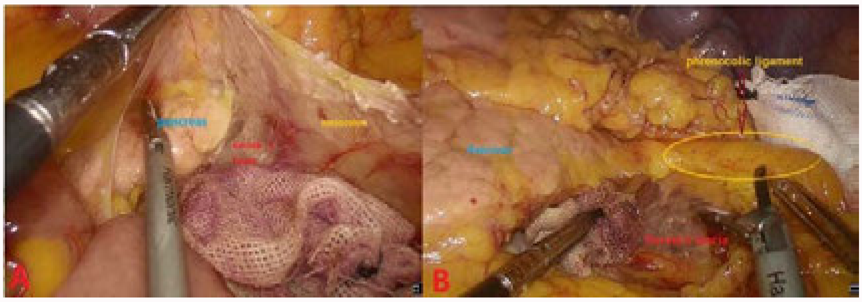

Figure 3: Dissection of the left hemicolon. A) CME procedure. B) Dissociation of the splenic flexure.

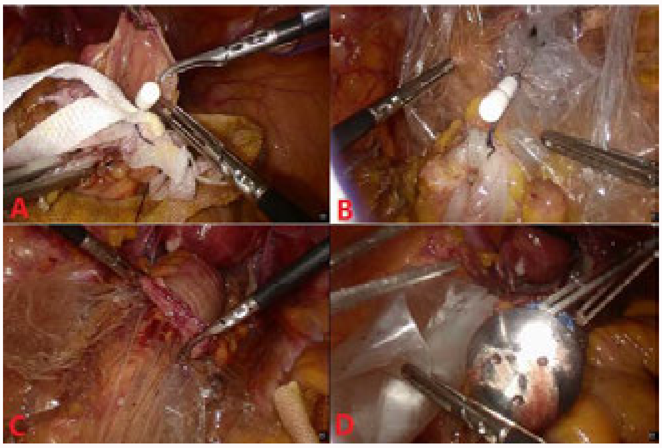

Figure 4: Specimen extraction (NOSE). A) Plastic bag was placed. B) The specimen was sutured to the gastric tube. C) The specimen was pulled out transanally. D) The anvil head was placed into the abdominal cavity.

was removed, the anvil head was placed into the abdominal cavity, and then the sigmoid colon was closed with a linear stapler (Figure 4).

Digestive tract reconstruction: The proximal colon was closed through manual purse string sutures placed manually. Then, the closed end was removed, the intestinal cavity was opened, and the anvil head was placed. Under direct observation, the end-to-end anastomosis was completed with a circular stapler. We placed reinforced sutures with absorbable strings, and the retroperitoneum was closed (Figure 5).

Results

The average operation time was 227.17 ± 65.51 min, and the intraoperative bleeding was 91.05 ± 66.71 ml. The average time needed to dissect the IMA and preserve the SRA was 14.58 ± 2.29 min. The average time needed to release the splenic flexure was 21.87 ± 3.20 min. The intracorporeal anastomosis time was 10.84 ± 3.20 min. The number of dissected lymph nodes was 16.41 ± 5.57. The time to ambulation was 12.42 ± 3.56 h, time to anal exhaust was 20.20 ± 10.08 h, and time to liquid intake was 2.86 ± 1.12 days. The average postoperative discharge time was 7.66 ± 1.89 days. One patient developed pulmonary infection after the operation. The patient was complicated with Chronic Obstructive Pulmonary Disease (COPD) before the operation and improved after anti-infection treatment. A patient developed a chyle fistula after the operation that was cured after conservative treatment, such as fasting. One patient developed an intestinal infection, which was cured after anti-infection treatment. Two patients had transient intestinal obstructions, which were relieved after 3 to 5 days of conservative treatment. No anastomotic leakages or pelvic abscesses occurred in this group.

Discussion

Preservation of the SRA has become a consensus that the blood supply of anastomosis is important to prevent anastomotic leakage. Based on Huang's meta-analysis and other studies, laparoscopic TME surgery with preservation of both the SRA and LCA for upper-rectal and sigmoid colon cancers may significantly receive better clinical and surgical outcomes with a less total postoperative complications, and lower anastomotic leakage rate [14,15]. About the oncologic outcomes of the SRA-preservation LN dissection, there was no significant differences in the number of harvested lymph nodes [15] and also the level of IMA ligation did not significantly affect long term outcomes of patients with sigmoid or rectal cancer after curative laparoscopic surgery [16]. In addition, preservation of IMA has the superiority in genitourinary function preservation [17]. When the dissection is performed away from the aortic plane, the risk of injury the superior hypogastric plexus and hypogastric nerves is significantly reduced, with a possible sparing effect on the genitourinary function [18,19].

However, preservation of the SRA is still controversial. The SRA preservation should guarantee a better blood supply of the sigmoid or rectal stump, but Munechika clarify the safety and feasibility of high ligation of the IMA in surgery for descending colon cancer using Indocyanine Green (ICG) fluorescence imaging [20]. And like the other research, ligation of inferior mesenteric vessels does not seem to affect anastomotic healing and there is not statistically significant anastomotic leakage between IMA preservation and IMA ligation

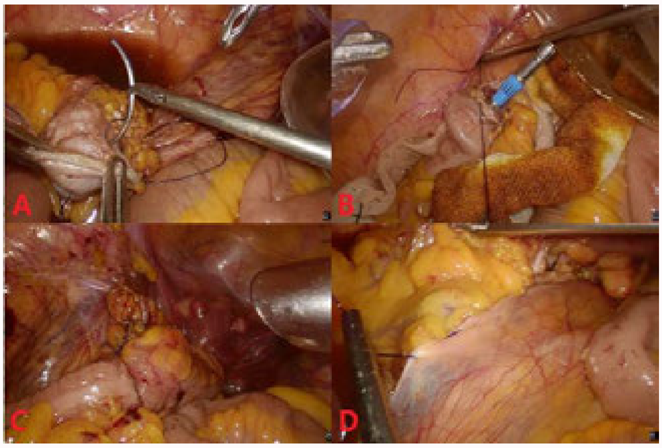

Figure 5: Digestive tract reconstruction. A) The proximal colon with a purse-string suture. B) The anvil head was placed. C) The end-to-end anastomosis was finished. D) The retroperitoneum was closed.

[21]. There is another pitfall of IMA preservation, the operation time was significantly longer in the IMA preservation [22,23].

Preservation of the SRA is somewhat similar to dissociation of Henle's gastrocolic trunk in right hemicolectomy. We often do not perform ligation at the root, as this will lead to future difficulties. This is because if the root is ligated, each branch needs to be dissociated again because the superior rectal artery does not represent the scope of the lymph nodes to be cleaned and needs to be preserved, and the SA and LCA need to be cleaned and severed. Therefore, not severing the IMA can maintain vascular tension, make it easier to perform vascular dissection, and simplify the operation. Of course, this is controversial. However, our clinical experience suggests that preservation of the main blood vessels for a second operation to treat recurrent colorectal cancer can guarantee a good blood supply of the bowel, avoiding excessive and extensive resection of the bowel. Of course, from a technical point of view, this method is also very easy to perform and master. In this group of patients, the average time needed to dissect the IMA and preserve the SRA was 14.58 ± 2.29 min.

At present, NOSES has become a preferred choice for laparoscopic colorectal surgery because it does not require additional abdominal incisions and leads to less postoperative pain, a faster postoperative recovery and better aesthetic effects [24]. The key point to NOSES is how to retract the specimen. There are two natural orifices for colorectal specimen extraction: the vagina and the anus. So far, there are many methods of transanal retrieval of specimens, such as methods using a camera sleeve [25] and the Transanal Endoscopic Microsurgery (TEM) [26,27], and have been widely used, but in the left colon, due to the longer specimen and presence of more mesangium, it was often difficult to pull out the specimen through the anus. Some surgeons tend to choose transvaginal specimen extraction, but this approach will also cause additional vaginal damage and is limited to female patients [28]. Paraiso et al. also reported a high rate of dyspareunia after the transvaginal approach for rectocele surgery [29]. The transanal access route of LA-NOSE is intuitively the optimal approach for colorectal surgery. To solve the problem that there was a far distance between the resected specimen and the natural orifice, Kayaalp applied a new technique of transcolonic extraction by colonoscopic assistance [30], but this technique requires both advanced laparoscopic experience by intracorporeal anastomosis and interventional endoscopy and this technique is only suitable for small specimens which can pass through the sigmoid colon. Another novel technique is the use of Cai tube to pull the descending colon, but this equipment is much the same as TEM [31]. If the sigmoid colon is too long, Cai tube is unsuitable. For this reason, we introduced a simple method for left colon specimen extraction; however, the patient's BMI and tumor diameter obviously need to be considered. When removing specimens from the left colon, there were problems such as more mesentery and longer bowel, and the specimen was hard to pull out. We solved the problem by using a gastric tube for traction. We placed the gastric tube into the abdominal cavity transrectum, and then the gastric tube and the specimen were sutured. The specimen was pulled out of the body transrectally. The whole process followed aseptic and tumor-free principles. None of the patients we reported had abdominal or pelvic infections. Based on some special tumor-free procedures under NOSES, Karagul reported no tumor recurrence at the extraction site in 21.1 months [32]. Our technique has been described in detail and demonstrated in the surgery **Video**.

Intracorporeal anastomosis is necessary for NOSES. Compared with traditional extracorporeal anastomosis, intracorporeal anastomosis has the advantages of less trauma and faster recovery. There have been many descriptions of intracorporeal anastomosis methods, such as triangular anastomosis, delta anastomosis, and reverse puncture anastomosis [33,34]. To date, there is no standard method for intracorporeal anastomosis. However, in these anastomotic methods, such as triangular anastomosis and delta anastomosis, more staples were needed, a dangerous triangle (postoperative anastomotic bleeding, anastomotic leakage) was observed, and the operation procedure was complicated. Longer intestinal segments were needed. Another author performed end-to-end transverse colon-sigmoid colon (rectal) anastomosis, which was more in line with the structural characteristics of the patient in anatomy and physiology, and the risk of anastomotic leakage and anastomotic bleeding after surgery was low. Planellas' research showed that end-to-end anastomosis has fewer complications and better recovery of bowel function [35]. In this group of patients, none had anastomotic leakage, anastomotic bleeding or anastomotic stenosis. Compared with delta anastomosis by Zhou and reverse puncture anastomosis by Xu, our end-to-end anastomosis did not significantly prolong the operation time.

Another serious complication after laparoscopic left hemicolectomy is transient or intestinal obstruction requiring reoperation. Studies have shown that in laparoscopic colorectal surgery, the incidence of postoperative small intestinal hernia was 0.65%, but most cases were in left colon surgery, accounting for 64.3% [36]. Because the small bowel mesenteric root is in the retroperitoneum, it is distributed from upper left to lower right, so the internal hernia is especially prone to occur in the left colon once the retroperitoneum is unclosed. Therefore, closing the peritoneum was the last important step in our operation. In our series of consecutive patients, no internal hernias occurred.

Conclusion

Patient safety and added benefits are the driving force behind our continued development of colorectal surgery. Laparoscopic left hemicolectomy (NOSES) with preservation of the SRA is very safe and effective, and the standard procedure is worth promoting. Of course, its long-term effect needs further observation.

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Video Link

Link : https://youtu.be/GNlpa3en6Co

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