Retrospective Clinical Research Report

Journal of INTERNATIONAL MEDICAL RESEARCH

Journal of International Medical Research
49(7) 1–8

DOI: 10.1177/03000605211019674
journals.sagepub.com/home/imr
SAGE

Short-term clinical and oncological outcomes after single-incision plus one-port laparoscopic surgery for rectosigmoid cancer: a retrospective clinical analysis of 30 cases

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Abstract

Objective: To evaluate the safety and feasibility of single-incision laparoscopic surgery+1 (SILS+1) radical resection of sigmoid and upper rectal cancer.

Methods: The clinical data of 30 consecutive patients with sigmoid and upper rectal cancer who underwent SILS+1 radical resection between October 2018 and January 2020 in our hospital were retrospectively analyzed. An initial 5-cm periumbilical transverse incision was made. Then, a multiport device was placed in the umbilical incision. Two 10-mm ports were used for laparoscope insertion, and the other two ports were used for laparoscope device insertion. A 12-mm trocar was placed in the right lower abdominal quadrant under laparoscopic view and served as the surgeon's dominant operating channel.

Results: All operations were performed successfully without conversion to conventional laparoscopic surgery or open operation. Three patients developed postoperative complications: one patient developed ileus, one developed postoperative bleeding, and one developed wound infection. There were no perioperative deaths.

Conclusions: The safety and feasibility of SILS+1 radical resection of sigmoid and upper rectal cancer was established by experienced surgeons in our study. However, further studies are needed to demonstrate the advantages of this procedure compared with the benefits of conventional laparoscopic surgery.

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Keywords
Upper rectal neoplasm, sigmoid colon neoplasm, laparoscopic surgery, single-incision laparoscopy plus one additional port (SILS+1), cancer, complication

Date received: 30 December 2020; accepted: 29 April 2021

Introduction

Colorectal cancer is one of the most common malignant tumors and poses a serious threat to people's health. Surgical resection of the primary tumor is still the only curative method.[1,2] The introduction of laparoscopy has led to a significant improvement in postoperative outcomes following colorectal resection because laparoscopy is associated with faster postoperative recovery, shorter length of hospital stay, and a potential reduction in postoperative mortality in the majority of surgical conditions compared with the open approach.[3–7]

Conventional multiport laparoscopic surgery (MPLS) requires multiple abdominal incisions, and each incision has potential morbidity risks, namely bleeding, herniation, and internal organ damage.[8,9] With developments in laparoscopic equipment and improvements in surgeons' expertise, laparoscopy has led to the development of more minimally invasive surgical approaches, such as mini-laparoscopy, natural orifice transluminal endoscopic surgery (NOTES) and, more recently, single-incision laparoscopy (SIL). However, although several clinical trials have been conducted, the technical feasibility and safety of NOTES, which was first reported in 2004,[10] have not been fully evaluated.[11] Although many studies have shown that SILS is superior to MPLS,[12] SILS has not been widely adopted because of the additional skill set required, technical challenges, and the need for increased minimally invasive surgical skill.[13] However, surgeon experience can overcome the technical and ergonomic challenges to ascend the learning curve with SILS.[14]

To overcome the challenges of SILS, we adopted the single-incision laparoscopic surgery+1 (SILS+1) technique. SILS+1 has been reported safe and feasible for colorectal surgery for colorectal cancer, and it offers short-term outcomes comparable to those of MPLS.[15] Although the potential benefit of SILS+1 compared with MPLS is debated, a recent randomized large-sample clinical trial showed that SILS+1 had better short-term outcomes.[16] We describe the methods used in our study and present our initial results of SILS+1 for cancer of the sigmoid colon and upper rectum.

Patients and Methods

Ethics

This study was conducted with approval from the Ethics Committee of the Affiliated Hospital of Putian University on 15 October 2018. This study was conducted in accordance with the Declaration of Helsinki. Written informed consent was obtained from all participants.

Study design and patient selection

This paper presents the results of a single-center, retrospective clinical study of SILS+1 for cancer of the sigmoid colon and upper rectum. This study was

conducted according to the guidelines for reporting observational studies.[17] Between October 2018 and January 2020, 30 consecutive patients who underwent elective laparoscopic colorectal resection for cancer of the sigmoid colon and upper rectum in our department were screened for inclusion. Diagnosis was confirmed by preoperative colonoscopy and computed tomography (CT) in all cases. The exclusion criteria were preoperatively diagnosed tumor invasion into adjacent organs (stage T4b), emergency cases, and severe medical illness. All procedures were performed by a single surgeon, and in all cases, patient consent regarding SILS+1 was obtained.

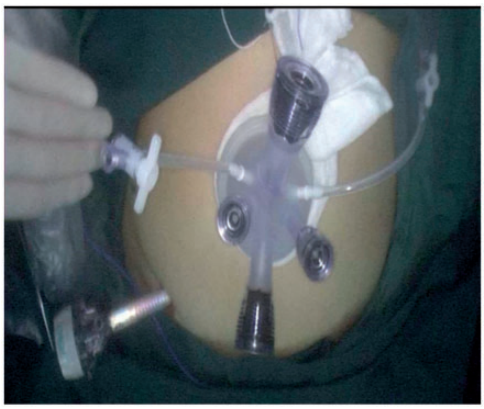

Figure 1. Multiport device placed in the umbilical incision and a 12-mm trocar placed in the right lower abdominal quadrant.

Definitions

Surgical site infection was defined as colonization of a pathogen in the wound. Anastomotic leakage was defined as a defect of the intestinal wall at the anastomotic site leading to a communication between the intra- and extraluminal compartments. Ileus was defined as intestinal obstruction characterized by a lack of peristalsis and leading to severe colicky pain and vomiting.

Surgical procedures and quality control

The surgeon who performed the procedures had completed over 100 successful MPLS cases and at least 10 successful SILS+1 cases. Surgery was performed according to a standardized procedure using standard laparoscopic instruments.

Under general anesthesia, patients were placed in the modified lithotomy position. An initial 5-cm periumbilical transverse incision was made. Then, a multiport device (Kangji Medical Instrument Ltd., Hangzhou, China) was placed in the umbilical incision, and the wound was protected. Two 10-mm ports were used for laparoscope insertion, and the other two ports were used for laparoscopic device insertion. A 12-mm trocar was inserted in the right lower abdominal quadrant under laparoscopic view, which served as the surgeon's dominant operating channel (Figure 1). The peritoneum was incised at the level of the promontorium above the bifurcation of the iliac artery, and the sigmoid colon was mobilized using a medial to lateral approach with the left ureter and gonadal vessels preserved. The dissection was continued superiorly to the level of the root of the inferior mesenteric artery. All soft tissues anterior to the inferior mesenteric artery were completely removed, and D3 lymph node dissection was achieved. Then, the root of the superior rectal artery and inferior mesenteric vein were divided. The lateral attachments of the sigmoid colon were dissected until the previously dissected area was reached, and full mobilization of the sigmoid colon was completed. All procedures complied with the principles of total mesorectal excision. After sufficient distal intestinal lavage with saline solution, the rectum was transected using an endoscopic linear stapler with a gold cartridge, which was inserted via the right lower quadrant port following rectal

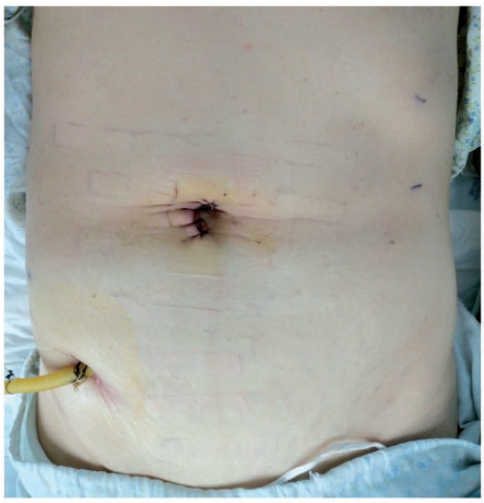

Figure 2. A pelvic drain was inserted postoperatively via the right lower abdominal quadrant incision.

lavage, and the specimen was retrieved through the umbilical port. Anastomosis was performed with the double stapling technique using a transanally inserted circular stapler. A pelvic drain was inserted via the right lower quadrant incision (Figure 2). The SILS port was closed with an interrupted mattress suture. The 12-mm trocar incision was not sutured except for one stitch to anchor the drain. Diverting stoma was not performed.

Results

Thirty patients were enrolled in this study between October 2018 and January 2020. The patients' demographics are shown in Table 1. The median age was 65.5 years (range: 42–91 years), and there were 11 female and 19 male patients. The median body mass index of the patients was 23.5 kg/m^2 (range: 18.3–34.5 kg/m^2). Seven tumors were located in the sigmoid colon and 23 were located in the upper rectum. Four patients had undergone previous abdominal surgery; one patient had undergone cesarean section, one patient had undergone gastrectomy, and two patients had undergone appendectomy. No patients received preoperative radiation or chemoradiotherapy, and all patients underwent SILS+1 without requiring an additional port or open surgery.

Table 1. Patient demographics (n = 30).

Parameter	
Diagnosis	
Sigmoid colon cancer	7
Upper rectal cancer	23
Sex	
Female	11
Male	19
ASA score	
1–2	22
3–4	8
Body mass index (kg/m^2)	23.5 (18.3–34.5)
Age (years)	65.6 (42–91)
Previous abdominal surgery	4
Neoadjuvant chemotherapy	0

Data are displayed as n or median (range). ASA, American Society of Anesthesiologists.

Perioperative clinical and oncological outcomes are shown in Table 2. The mean incision length was 4.3 ± 0.8 cm, the average operative time was 125 ± 35.3 minutes, and the average intraoperative blood loss volume was 32 ± 25 mL. We used one laparoscopic stapler to transect the upper rectum. Patients were discharged 7.3 ± 3.2 days postoperatively, and the drain was removed 2.3 ± 1.2 days postoperatively. The average time to return of bowel function was 2.6 ± 1.2 days. No patients required a protective defunctioning ileostomy, and no mortalities were associated with the procedure.

Three patients developed postoperative complications. One patient required readmission because of ileus, one patient developed postoperative bleeding and was treated with conservative therapy, and one patient developed wound infection.

Table 2. Perioperative clinical and oncological outcomes (n = 30).

Parameter	
Operative time (minutes)	125 ± 35.3
Conversion rate	0
Additional port	0
Incision length (cm)	4.3 ± 0.8
Estimated blood loss (mL)	32 ± 25
Length of stay (days)	7.3 ± 3.2
Drainage duration (days)	2.3 ± 1.2
Time to return of bowel function (days)	2.6 ± 1.2
Bleeding	1
Small bowel obstruction	1
Mortality	0
Anastomotic leak	0
Reoperation	0
Extra analgesia	0
Wound infection	1
Re-admission within 30 days of surgery	0
Port site hernia	0
Ileostomy (n, %)	0
Incisional hernia	0
Tumor diameter (cm)	3.5 ± 1.7
Proximal resection margin (cm)	6.4 ± 2.5
Distal resection margin (cm)	5.23 ± 1.45
TNM classification (0/I/II/III/IV)	0/6/13/9/2
Lymph node harvest	22.1 ± 11.2
R0 resection	30

Data are n or mean ± standard deviation, unless otherwise indicated. TNM, tumor, node, metastasis.

There were no deaths, anastomotic leaks, incisional hernias, or trocar hernias in any cases. No patients required reoperation, and no patients required additional analgesia.

Oncological outcomes are shown in Table 2. The mesorectum of the specimens were macroscopically intact in all cases. The mean number of dissected lymph nodes was 22.1 ± 11.2; all surgical margins were negative; and the mean distal margin of the specimen was 5.23 ± 1.45 cm. The pathological stages constituted stage I (n = 6), stage II (n = 13), stage III (n = 9), and stage IV (n = 2).

During the follow-up period, which ranged from 6 to 18 months, none of the patients developed neurogenic bladder, and none of the male patients developed sexual dysfunction. Scars were satisfactory regarding cosmesis and met our expectations. No tumor recurrence was reported during follow-up.

Discussion

To ensure the safety of surgery and radical cure of cancer, many surgeons now perform more minimally invasive surgeries in the treatment of colorectal cancers. Surgeons have also attempted to reduce the number and size of the laparoscopic ports to reduce parietal trauma and improve cosmetic results. Accordingly, SILS was developed

and allows laparoscopic procedures to be completed using trocars located in one umbilical incision.[18] The application of SILS for colorectal surgery has emerged recently;[19] however, data regarding pure single-incision laparoscopic rectal cancer surgery, including low rectal cancer surgery, are rare because of the technical difficulties, including rectal transection. The aim of our study was to evaluate the short-term clinical and oncological safety of SILS+1 for sigmoid colon and upper rectal cancer. The results suggested that SILS+1 for sigmoid colon and upper rectal cancer has the advantages of short operation time, fewer complications, less postoperative pain, and rapid recovery.

Compared with SILS, SILS+1 has several advantages. First, eliminating the linear visual field is beneficial to the operator's judgment of distance and depth. In addition, eliminating the "coaxial effect" or "chopstick effect" between instruments alleviates the fight against tissue traction and facilitates forming the "operation triangle". Moreover, in sigmoid colon and upper rectal cancer, which was the focus of this study, experienced surgeons can operate alone to reduce interference between extra-abdominal instruments. Furthermore, Tsujinaka et al.[20] reported that pelvic drainage may act as an early detector of anastomotic leaks and reduce the need for reoperation in select patients undergoing rectal cancer surgery; we agree, and routinely use pelvic drains in the right lower abdominal quadrant. Finally, SILS+1 facilitates linear stapler firing closer to the vertical amputation of the rectum in the pelvic cavity to increase the safety of the anastomosis.

The application of a new surgical method for the treatment of patients with tumors must ensure the safety of the surgery and radical cure of the cancer. Surgical safety is the most important factor, and this can be reflected in the operation time and perioperative complications. In our study, three patients had perioperative complications, which allows us to conclude that SILS+1 for sigmoid colon and upper rectal cancer is clinically safe and feasible. Second, tumor treatment must follow the principle of radical tumor resection, including the resection margins and the dissection of a number of lymph nodes and the mesorectum fasciae of the specimens. Regarding lymph node dissection in colorectal surgery, resecting 12 lymph nodes is required to ensure oncological safety.[21] In our study, the median number of harvested lymph nodes was 22.1, which exceeded the recommended number of 12 nodes. Wang Y et al.[16] reported no significant difference in the number of harvested lymph nodes and proximal and distal resection margins between the SILS+1 and the conventional laparoscopic surgery (CLS) group, which may limit the adoption of SILS+1 for colon cancer. The oncological outcomes of our study showed an increased median number of harvested lymph nodes and decreased proximal and distal resection margins compared with findings in Wang Y et al.'s study. The differences probably relate to different inclusion and exclusion criteria. Our findings suggest that SILS+1 may offer more benefits to patients with cancer of the sigmoid colon and upper rectum. Nagtegaal et al.[22] showed that patients with an incomplete mesorectum had a significantly higher risk of local recurrence. In our study, the mesorectum fasciae of the resected specimens were macroscopically intact in all cases.

Because the navel is a natural scar, transumbilical surgery can achieve a more cosmetic result. However, it is also a relatively dirty area, and it must be cleaned before the operation to avoid postoperative incision infection. Although we encountered one case of incision infection, most patients

were satisfied with the postoperative cosmetic results.

Our study has several limitations. First, this was a single-center and retrospective study, which explains the small sample size. Second, we did not perform long-term follow-up to determine 3-year disease-free survival, 5-year total survival, and long-term postoperative hernia rate, versus MPLS. Because this study aimed to evaluate the safety of SILS+1 for patients with cancer of the sigmoid colon and upper rectum, we did not collect clinical data on the differences between SILS+1 and SILS or traditional surgery. A multicenter clinical study comparing SILS+1 and SILS or traditional surgery is needed.

Conclusion

We documented the feasibility and short-term clinical and oncological safety of SILS+1 for sigmoid colon and upper rectal cancer performed by experienced surgeons. This procedure is a promising alternative as it eliminates the need for multi-port laparoscopic abdominal surgery to treat some patients with sigmoid colon and upper rectal cancer. Further studies are needed to demonstrate the advantages of SILS+1 compared with the benefits of conventional laparoscopic surgery.

Acknowledgment

We would like to acknowledge the hard and dedicated work of all of the staff involved in implementing the intervention and evaluation components of the study.

Declaration of conflicting interest

The authors declare that there is no conflict of interest.

Funding

This research received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors.

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