

Review

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Reduced-port surgery for rectal cancer

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Abstract

Laparoscopic surgery for rectal cancer has short-term and long-term oncological outcomes similar to those of open surgery. Conventional multiport laparoscopic surgery (CMLS) for rectal cancer requires four or five abdominal incisions for trocars, each of which could lead to complications and/or pain. Single-incision laparoscopic surgery (SILS) would reduce the incidence of such wound-related complications and achieve better cosmetic outcomes relative to CMLS. The potential advantages of SILS are less pain and more rapid recovery than achieved with CMLS. However, SILS is rarely used for rectal cancer because of the high-level technical expertise required. Reduced-port laparoscopic surgery (RPS), which involves one additional port, may bridge the technical gap between CMLS and SILS and has a less steep learning curve. RPS for rectal cancer has a short history, and its usefulness has not yet been fully established. Here, we review the present situation, challenges, and future prospects for RPS for rectal cancer.

Keywords: Laparoscopic surgery, rectal cancer, reduced port surgery

INTRODUCTION

Large randomized trials [Conventional versus laparoscopic-assisted surgery in colorectal cancer (CLASICC), Clinical Outcomes of Surgical Therapy (COST), Barcelona, JCOG0404] and a meta-analysis have demonstrated that laparoscopic surgery for colon cancer is not only safe, but also associated with better short-term outcomes, with no negative effect on long-term survival^[1-5]. They also revealed trends toward reduced postoperative morbidity, intraoperative blood loss, and pain, as well as faster recovery and better quality of life for laparoscopic surgery compared with open surgery^[1,4,6-9]. The disadvantages were a longer



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operating time, higher theater costs, and a steep learning curve. However, the long-term recurrence rate was similar and no significant difference was found in the disease-free survival (DFS) or overall survival (OS) rate^[4]. Therefore, laparoscopic surgery is now considered to be an acceptable approach for colon cancer.

However, some controversy surrounds the non-inferiority of laparoscopic surgery to open surgery for rectal cancer in terms of long-term outcomes. Two previous large randomized controlled trials (RCTs), the Colorectal Cancer Laparoscopic or Open Resection (COLOR) II and Comparison of Open versus laparoscopic surgery for mid or low Rectal cancer After Neoadjuvant chemoradiotherapy (COREAN) trials, and several meta-analyses showed similar pathological and oncological outcomes of laparoscopic and open approaches for rectal cancer, and the laparoscopic approach is now a standard alternative to the open approach^[5,10-13]. However, two more recent RCTs, the ALaCaRT and ACOSOG Z6051 trials, yielded contradictory results, and failed to show the non-inferiority of laparoscopic to open rectal resection^[14,15]. The most recent meta-analysis showed that the risk of a positive circumferential resection margin in rectal cancer was significantly greater for laparoscopic than for open surgery^[16]. Although laparoscopic surgery might be useful for the treatment of rectal cancer in selected patients, the evaluation of long-term outcomes is needed to determine whether the poor pathological outcomes have adverse effects on DFS or OS.

Laparoscopic procedures are becoming less invasive. Conventional multiport laparoscopic surgery (CMLS) for colorectal cancer (CRC) requires four or five abdominal incisions for trocars, and each incision could be associated with wound complications and pain^[17]. Single-incision laparoscopic surgery (SILS) would reduce the incidence of such wound-related complications and achieve better cosmetic outcomes relative to CMLS. The potential advantages of SILS over CMLS are less pain and early recovery. Indeed, SILS reportedly has more acceptable short-term outcomes compared with CMLS^[18-21]. In addition, it has been reported that SILS performed by experienced laparoscopic surgeons for selected patients can be an oncologically safe option^[22-24]. However, SILS is a highly demanding procedure with several technical challenges, such as the handling of conventional laparoscopic instruments through small incisions, which could decrease the range of motion, and the potential for collisions between instruments and the camera. As a result, SILS also has disadvantages, such as a longer operation time, increased surgeon fatigue, and a steep learning curve. Reduced-port laparoscopic surgery (RPS), which is single-port surgery with one additional port, may overcome the limitations of SILS while retaining its advantages.

Here, we review the present situation, challenges, and future prospects of the use of RPS for CRC.

A comprehensive literature search was performed following an electronic search of PubMed@. Articles published in the English language between January 2013 and June 2018 were evaluated using the key terms “RPS, CRC” or “SILS, CRC”. Case reports or small case series (< 20 cases) were excluded.

CMLS, SILS, AND RPS PROCEDURES FOR RECTAL CANCER CMLS

CMLS for CRC is usually performed via the five-port method, with an umbilical camera port, two operator ports, and two assistant ports^[25] [Figure 1A]. The left colon is initially mobilized laterally to medially to the extent required for identification of the left ureter and left hypogastric nerve plexus. Mobilization of splenic flexure is performed if necessary. After intracorporeal high ligation of the inferior mesenteric vessels, mobilization of the rectum and mesorectum is performed. After mobilization of the rectum, a 3-4 cm abdominal-wall incision is made to extract the specimen. Bowel anastomosis is performed intracorporeally for anterior resection using a double-stapling technique.

SILS and RPS

A vertical 3 cm incision is made in the umbilicus and a multiple-instrument access port (MIAP) is placed

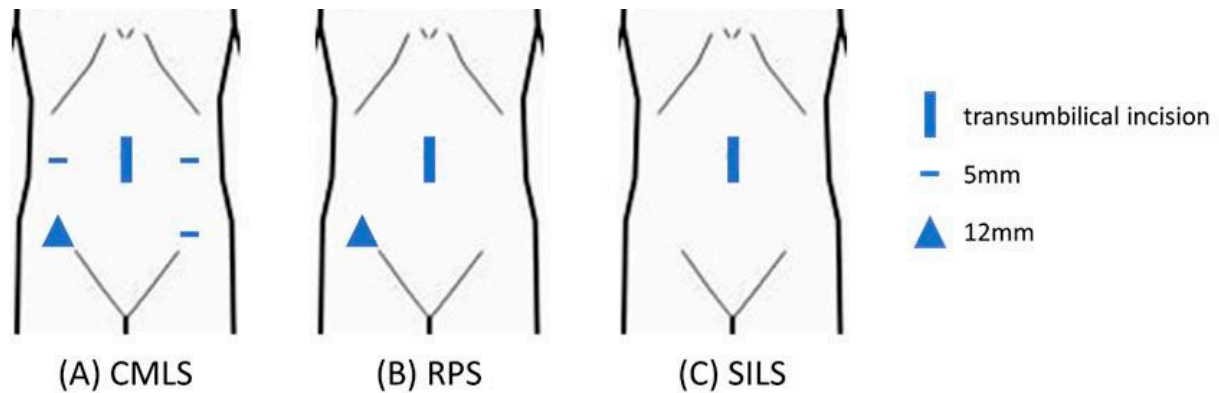


Figure 1. Trocars placement in conventional (A), reduced port (B) and single incision (C) laparoscopic surgery for rectal cancer

at the site^[26]. SILS is performed entirely through this access port^[27]. For RPS, an additional port is inserted on the operator's dominant-hand side [Figure 1A and C]. The assistant uses one channel of the MIAP to create a working view, and a 5 mm flexible-tip laparoscope is inserted through the other MIAP channel. A flexible laparoscope is useful for preventing interference from the hand instruments. After mobilization of the rectum, the transumbilical site is used to extract the specimen, and bowel anastomosis is performed in the same manner as in CMLS.

SILS compared with CMLS

Although no RCT on the subject has been performed, the most recent systematic review showed that colorectal SILS is at least as feasible and safe as CMLS in selected patients with rectal cancer^[17]. SILS had outcomes comparable to those of CMLS in terms of operating time, conversion rate, reoperation rate, postoperative complication rate, and mortality rate. The oncological results of SILS for CRC were satisfactory, as demonstrated by similar average lymph-node retrieval and adequate resection margins relative to those obtained with CMLS. Nevertheless, long-term follow-up data on survival and local recurrence rates are lacking. In addition, colorectal SILS is technically limited because of instrument crowding, in-line viewing, and insufficient countertraction^[24,28]. In particular, cutting of the distal rectum from the umbilicus using a linear stapler is technically difficult^[29]. Therefore, the authors of the systemic review concluded that they could not recommend the use of SILS instead of CMLS for CRC^[17].

RPS compared with CMLS

RPS has become more feasible due to the accumulation of experience and improvement of laparoscopic tools, such as energy devices and specific forceps. Although they included relatively few patients with rectal cancer, four retrospective studies have compared RPS with CMLS for the treatment of this disease^[27,30-32]. The advantages of RPS over CMLS are summarized in Table 1. No RCT, systematic review, or meta-analysis has compared the outcomes of RPS and CMLS. An RCT of the short-term surgical and long-term oncological safety of RPS compared with CMLS for rectosigmoid colon cancer is underway^[33].

One study evaluated long-term oncological outcomes after RPS for rectosigmoid cancer. Liu *et al.*^[27] reported that the 3-year DFS and OS rates were comparable between the RPS and CMLS groups.

Regarding short-term outcomes, the operation time is shorter for RPS than for CMLS^[27,30,31], possibly due to selection bias^[30,31] or a decreased time to wound closure as a result of the fewer and smaller wounds created during RPS^[30].

RPS is less invasive than CMLS and results in shorter times to flatus passage, liquid diet consumption, and

Table 1. Retrospective studies comparing reduced port laparoscopic surgery and conventional multiport laparoscopic surgery (CMLS) for colorectal cancer (CRC)

Author	Publication year	Reference	Total patients included (RPS vs. CMLS)	Accrual	Difference seen in RPS	
Kang <i>et al.</i>	2018	31	73 vs. 111	2011-2017	Operation time Gas passage time	Shorter Longer
Song <i>et al.</i>	2016	32	32 vs. 217*	2011-2013	Operation time Blood loss Gas passage time Pain	Shorter Less Shorter Less
Liu <i>et al.</i>	2017	27	48 vs. 48**	2011-2014	3Y DFS 3Y OS Operation time Total incision length Time to liquid diet Time to ambulation Discharge Pain Postoperative CRP and IL-6 levels Cosmesis	N.S. N.S. Shorter Shorter Shorter Shorter Less Less Lower Better
Kawamata <i>et al.</i>	2014	33	20 vs. 20	2010-2012	Operation time Postoperative neutrophil counts Postoperative body temperature	N.S. Lower Lower

RPS: Reduced-port laparoscopic surgery

ambulation^[27,31]. In addition, RPS leads to less postoperative pain and better cosmetic results than does CMLS because of the shorter total incision length^[27,31]. Therefore, patients who undergo RPS have better postoperative outcomes. However, the estimated blood loss, morbidity rate, conversion rate, and number of harvested lymph nodes were comparable, suggesting that RPS is a feasible and safe procedure in the early postoperative stage^[27,30]. Furthermore, the postoperative neutrophil count, C-reactive protein level, interleukin-6 level, and body temperature were significantly lower after RPS compared with CMLS^[27,32], which may accelerate recovery. Another advantage of RPS may be its cost effectiveness. The instrument cost for RPS may be lower due to the reduced number of trocars required; however, previous studies have not evaluated this factor. A shortened hospital stay and decreased analgesic use may also reduce the cost^[34,35].

A MIAP can be placed at the ileostomy site and the excised specimen can be brought out during a reduced port laparoscopic low anterior resection with diverting ileostomy. Furthermore, a drainage tube can be placed via the additional port^[36]. The use of MIAP as the ileostomy site represents a minimally invasive approach that results in a scarless procedure.

Superiority of RPS over SILS

RPS for CRC may have several advantages over CMLS. Since Burcher *et al.*^[37] performed the first SILS for colorectal diseases, it has become widely used because of technical advancements. However, SILS has a risk of collisions between instruments and is limited by use of triangular tissue traction^[21,24,38]; consequently, SILS is used infrequently worldwide^[36]. In contrast, the additional port created during RPS reduces the risk of collision between surgical instruments and the laparoscope, as well as shortening the operation time compared with SILS^[27]. Therefore, RPS involves fewer technical difficulties than does SILS. Moreover, RPS has other advantages over SILS, such as the convenience of an intracorporeal suture and stable drain placement via the additional port.

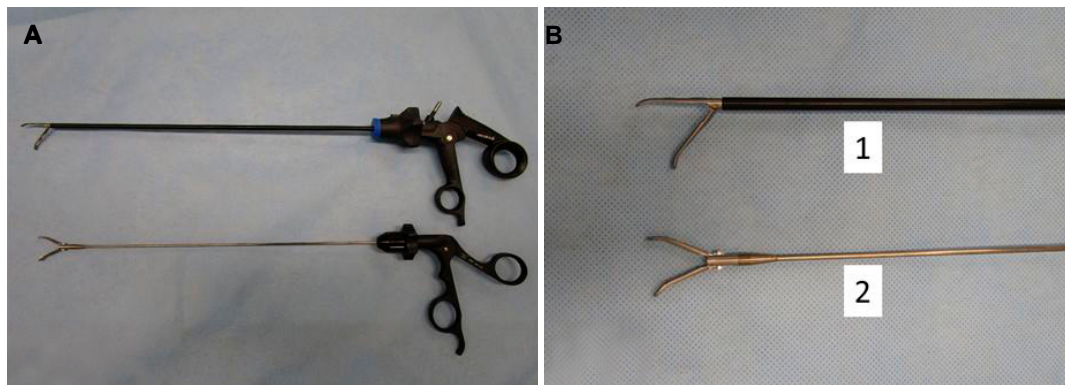


Figure 2. (A): Gross view of the instruments used in needlescopic surgery; (B): close up of the tips of the instruments shown in (A); 1: conventional 5 mm forceps; 2: same-sized tip section as that of the 5 mm forceps with a 2.4 mm-diameter shaft

SILS was initially expected to result in less postoperative pain compared with CMLS. However, this argument is controversial; indeed, the degree of postoperative pain after SILS is reportedly similar to or greater than that following CMLS^[39-41]. Although SILS involves fewer incision sites, the single incision could be lengthened and stretched by insertion of a single port due to the challenges of handling conventional laparoscopic instruments^[27]. This factor might explain the postoperative pain after SILS. The advantages of RPS are a reduced level of technical difficulty and cosmetic outcomes similar to those of SILS, and an operation time comparable to that of CMLS. In addition, the lengthening and stretching of the single incision are reduced during RPS relative to SILS, which may decrease postoperative pain. The results of a large prospective RCT comparing RPS with CMLS are awaited^[33].

Future perspectives

RPS may be superior to SILS for CRC, as it has a lower level of technical difficulty while maintaining less invasiveness. However, RPS is typically performed by a single surgeon and a laparoscopist, and has a steep learning curve because the reduced number of ports interferes with forceps mobilization, leading to less effective countertraction and visualization. Therefore, RPS may still be difficult to perform for less experienced surgeons.

To overcome this difficulty, needlescopic surgery, which involves the use of forceps with a small-diameter shaft instead of the conventional 5 mm port, has been developed^[42] [Figure 2]. Although the feasibility of needlescopic surgery compared with CMLS for CRC has been evaluated^[43,44], needlescopic surgery is expected to be less invasive and produce better cosmetic outcomes than CMLS. In addition, needlescopic surgery for CRC does not increase surgeon stress, as it is basically identical to CMLS for all surgical procedures. The disadvantages of the use of a small-diameter shaft in needlescopic surgery are the low shaft stiffness and inability to exchange instruments^[42]. However, the stiffness and operability of these tools have gradually been improved.

Although further prospective randomized studies of RPS (including needlescopic surgery) compared with CMLS for CRC are required, needlescopic surgery for CRC may be a good starting point for young surgeons and make feasible even less-invasive surgery.

CONCLUSION

Although further investigation is required, the surgical and oncological outcomes of SILS and RPS suggest that they are safe and feasible procedures. RPS may be superior to SILS due to its lower level of technical

difficulty while maintaining less invasiveness.

DECLARATIONS

Author's contributions

Design, manuscript writing: Shigeta K, Ishida T

Literature research, data analysis: Ishida T

Manuscript editing: Okabayashi K, Tsuruta M, Hasegawa H, Kitagawa Y

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All authors declared that there were no conflicts of interest.

Ethical approval and consent to participate

Not applicable.

Consent for publication

Not applicable.

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