World Journal of Gastroenterology

Online Submissions: http://www.wjgnet.com/esps/
bpgoffice@wjgnet.com
doi:10.3748/wjg.v19.i46.8543

World J Gastroenterol 2013 December 14; 19(46): 8543-8551
ISSN 1007-9327 (print) ISSN 2219-2840 (online)

TOPIC HIGHLIGHT

WJG 20th Anniversary Special Issues (5): Colorectal cancer

Early rehabilitation programs after laparoscopic colorectal surgery: Evidence and criticism

Duck-Woo Kim, Sung-Bum Kang, Soo-Young Lee, Heung-Kwon Oh, Myung-Hoon In

Duck-Woo Kim, Sung-Bum Kang, Soo-Young Lee, Heung-Kwon Oh, Myung-Hoon In, Department of Surgery, Seoul National University Bundang Hospital, Seongnam 463-707, South Korea

Author contributions: Kim DW and Kang SB designed research; Kim DW, Lee SY, Oh HK and In MH performed research; Kim DW, Kang SB, Oh KW and In MH analyzed data; Kim DW, Kang SB and Lee SY wrote the paper.

Correspondence to: Sung-Bum Kang, Associate Professor, Department of Surgery, Seoul National University Bundang Hospital, 300 Gumi-dong, Bundang-gu, Seongnam 463-707, South Korea. kangsb@snubh.org
Telephone: +82-31-7877093 Fax: +82-31-7874055

Received: September 25, 2013 Revised: November 1, 2013
Accepted: November 12, 2013
Published online: December 14, 2013

Abstract

During the past several decades, early rehabilitation programs for the care of patients with colorectal surgery have gained popularity. Several randomized controlled trials and meta-analyses have confirmed that the implementation of these evidence-based detailed perioperative care protocols is useful for early recovery of patients after colorectal resection. Patients cared for based on these protocols had a rapid recovery of bowel movement, shortened length of hospital stay, and fewer complications compared with traditional care programs. However, most of the previous evidence was obtained from studies of early rehabilitation programs adapted to open colonic resection. Currently, limited evidence exists on the effects of early rehabilitation after laparoscopic rectal resection, although this procedure seems to be associated with a higher morbidity than that reported with traditional care. In this article, we review previous studies and guidelines on early rehabilitation programs in patients undergoing rectal surgery. We investigated the status of early rehabilitation programs in rectal surgery and analyzed the limitations of these studies. We also summarized indications and detailed protocol components of current early rehabilitation programs after rectal surgery, focusing on laparoscopic resection.

Key words: Colorectal cancer; Enhanced recovery after surgery; Early rehabilitation; Fast-track; Laparoscopy; Rectal

Core tip: Several randomized trials and meta-analyses have confirmed that the implementation of early rehabilitation programs for perioperative care is useful for recovery of patients after colorectal resection. However, most of the previous evidence is obtained from studies of early rehabilitation programs adapted to open colonic resection. Currently, early rehabilitation combined with laparoscopic rectal surgery can be a feasible alternative in some selected patients, but indications are not established. Current evidence fails to support the safety of early rehabilitation combined with laparoscopic rectal surgery compared to that reported for laparoscopic colon surgery.

Kim DW, Kang SB, Lee SY, Oh HK, In MH. Early rehabilitation programs after laparoscopic colorectal surgery: Evidence and criticism. *World J Gastroenterol* 2013; 19(46): 8543-8551 Available from: URL: http://www.wjgnet.com/1007-9327/full/v19/i46/8543.htm DOI: http://dx.doi.org/10.3748/wjg.v19.i46.8543

INTRODUCTION

Previously, patients undergoing colorectal surgery received traditional perioperative care, which comprised sufficient mechanical bowel preparation, insertion of a

nasogastric tube, preoperative fasting, postoperative fasting for up to 1 wk, and multiple intra-abdominal drains. Eventually, early rehabilitation programs were developed to decrease postoperative pain, perioperative physiological stress, and organ dysfunction, and to promote patient motivation, leading to enhanced recovery after surgery; decreased postoperative morbidity, length of hospital stay, and health care resources; and improved overall outcomes[1]. Since their first introduction in the mid-1990s, early rehabilitation programs, also known as fast-track pathways or enhanced recovery after surgery (ERAS), have become increasingly popular in the care for patients with colorectal surgery[2].

During the past several decades, many studies have reported the results of early rehabilitation programs in colorectal surgery. Several randomized controlled trials and meta-analyses have indicated that the implementation of these evidence-based detailed perioperative care protocols is useful for early recovery of patients after colorectal resection[3-7]. Patients who underwent these programs showed rapid recovery of bowel movement, shortened length of hospital stay, and fewer complications compared with traditional care programs. However, most evidence from previous studies corresponded to patients undergoing colonic surgery for various diseases. Currently, the strongest evidence for early rehabilitation programs was adopted from open colonic resection[8]. At present, early rehabilitation programs in rectal surgery require standardization and can be adopted only after validation with high-level evidence from well-designed randomized controlled trials.

In this review, we summarized early rehabilitation programs reported in previous studies and guidelines including patients undergoing rectal surgery, and we analyzed the limitations of these studies. We also summarized indications and details of current early rehabilitation programs after rectal surgery, focusing on a laparoscopic resection perspective.

EARLY REHABILITATION PROGRAMS AFTER RECTAL SURGERY: STATUS QUO

Early rehabilitation and laparoscopic colonic surgery

Laparoscopic colorectal surgery has been established as a comparable alternative to open surgery with respect to its feasibility, safety and long-term outcomes. For malignant diseases, laparoscopic colonic resection performed by an experienced surgeon involves adequate lymph node harvest, sufficient surgical margins, and reduced operative time and intraoperative blood loss[8]. A previous study suggested that laparoscopic surgery could reduce the prevalence of postoperative immunosuppression[9]. Prospective randomized trials have shown that laparoscopic surgery for colon cancer can achieve earlier recovery in organ function and long-term oncological results equal to those for open colonic resection[10-12]. However, these trials did not apply early rehabilitation programs. Both laparoscopic surgery and early rehabilitation programs focus on minimizing surgical pain and perioperative stress, and enhancing recovery after surgery. Many cohort series, meta-analyses, and several prospective randomized studies showed early rehabilitation programs and laparoscopic surgery can have a synergistic effect in enhancing recovery after laparoscopic surgery for colon disease[9,13,14]. Recently, the Laparoscopy and/or Fast-track Multimodal Management Versus Standard Care (LAFA) study, the largest multicenter randomized controlled trial thus far, reported comparative results between laparoscopic and open colectomy[9]. The total length of hospital stay was 2 d less than that after laparoscopic surgery. Furthermore, laparoscopic surgery was the only predictive factor associated with reduced hospital stay and morbidity. The results from the LAFA study also indicated that early oral intake, early mobilization, and laparoscopic surgery were independent determinants of early recovery[9,15]. In a previous study, we evaluated the efficacy of a rehabilitation program after laparoscopic colon surgery in the context of a randomized controlled trial. We found that the recovery time was shorter in the early rehabilitation program group than in the conventional care group, without differences in complication rates, quality of life, and pain[13]. Previous studies representative of laparoscopic colon surgery with early rehabilitation are summarized in Table 1. As early rehabilitation programs became more popular in the management of patients undergoing colon surgery, an international collaborative research group proposed a set of guidelines for perioperative care in elective colonic surgery, with the participation of the ERAS Society for Perioperative Care, The European Society for Clinical Nutrition and Metabolism, and The International Association for Surgical Metabolism and Nutrition[16]. These guidelines recommend detailed protocols for each component ranging from patient selection to hospital discharge, and provide additional consideration points in the setting of laparoscopic surgery.

Early rehabilitation and laparoscopic rectal surgery

Laparoscopic rectal resection for various benign and malignant diseases, including total mesorectal excision, is considered technically challenging and has not gained popularity compared to laparoscopic colon resection. However, several studies have demonstrated that it is a feasible and safe alternative to open rectal surgery; some authors have reported that the short- and long-term oncological results were equal to those with open surgery[17-20]. We also reported the results of our multicenter study comparing open *vs* laparoscopic surgery for mid-rectal and low rectal cancer after neoadjuvant chemoradiotherapy (COREAN trial), which showed that laparoscopic surgery was safe and had short-term benefits, including earlier recovery of bowel function, shorter time to resume a normal diet, shorter time to first defecation, and less requirement for morphine, compared with open surgery[21]. Similarly, the quality of oncological resection was equivalent. Patients enrolled in the COREAN trial received postoperative management consisting of tradi-

Table 1 Previous representative studies of colonic surgery with early rehabilitation programs

Ref.	Country	Study design	Inclusion period	Patients (*n*)	Operations	Approach	LOS (d)		Readmissions		Morbidity		Mortality	
							ERP	CC	ERP	CC	ERP	CC	ERP	CC
Anderson *et al*[3], 2003	United Kingdom	RCT	ND	25 (ERP: 14, CC: 11) Cancer: 18 (72) ERP: 11, CC: 7	RH: 14 (ERP: 9, CC: 5) LH: 11 (ERP: 5, CC: 6)	ND	3 (2-7)	7 (4-10)[a]	0 (0)	0 (0)	4 (29)	5 (45)	0 (0)	1 (9)
Gatt *et al*[4], 2005	United Kingdom	RCT	ND	39 (ERP: 19, CC: 20) Cancer: 27 (69) ERP: 12, CC: 15	RH: 10 (ERP: 5, CC: 5) AR: 15 (ERP: 5, CC: 10) Others: 14 (ERP: 9, CC: 5)	ND	5 (4-9)	7.5 (6-10)[a]	1 (5)	4 (20)	9 (47)	15 (75)	1 (5)	0 (0)
Khoo *et al*[5], 2007	United Kingdom	RCT	2003-2004	70 (ERP: 35, CC: 35) Cancer: 70 (100)	Colonic: 47 (ERP: 22, CC: 25) Rectal: 23 (ERP: 13, CC: 10)	Open	5 (3-37)	7 (4-63)[a]	3 (9)	1 (3)	9 (26)	16 (46)	0 (0)	2 (6)
Muller *et al*[6], 2009	Switzerland	RCT	2004-2006	151 (ERP: 76, CC: 75) Cancer: 131 (87) ERP: 67, CC: 64	RH: 48 (ERP: 26, CC: 22) AR/LH: 101 (ERP: 30, CC: 51)	Open	5 (2-30)	9 (6-30)[a]	3 (4)	2 (3)	16 (21)	37 (49)[a]	0 (0)	0 (0)
Serclova *et al*[7], 2009	Czech	RCT	2005-2007	103 (ERP: 51, CC: 52) Cancer: 7 (7) ERP: 3, CC: 4 IBD: 89 (86) ERP: 46, CC: 43	Simple: (ERP: 47.1%, CC: 61.5) Multiple: (ERP: 29.4%, CC: 21.2)	Open	7 (5-11)	9 (7-22)[a]	0 (0)	0 (0)	11 (22)	25 (48)[a]	0 (0)	0 (0)
Lee *et al*[13], 2011	South Korea	RCT	2007-2009	100 (ERP: 46, CC: 54) Cancer: 100 (100)	RH: 38 (ERP: 17, CC: 21) LH: 15 (ERP: 5, CC: 10) AR: 47 (ERP: 24, CC: 23)	Lap	7 (6-8)	8 (7-9)	0 (0)	0 (0)	6 (11)	14 (20)	0 (0)	0 (0)
Vlug *et al*[9], 2011	Netherlands	RCT	200 -2009	400 (ERP: 193, CC: 207) Cancer: 400 (100)	RH: 179 (ERP: 80, CC: 99) LH: 221 (ERP: 120, CC: 101)	Open/lap	Open: 7 (5-11) Lap: 5 (4-8)	Open: 7 (6-13) Lap: 6 (4.5-9.5)[a]	13 (7)	14 (7)	125 (65)	132 (64)	6 (3)	4 (2)
Wang *et al*[26], 2012	China	RCT	2006-2009	78 (ERP: 40, CC: 38) Cancer: 78 (100)	RH: 13 (ERP: 7, CC: 6) Sig: 34 (ERP: 18, CC:16) AR: 25 (ERP: 13, CC: 12)	Lap	5.5 (5-6)	7.0 (6-8)[a]	ND	ND	2 (5)	8 (21)	0 (0)	0 (0)

[a]$P < 0.05$ *vs* early rehabilitation program (ERP) group. LOS: Length of hospital stay; CC: Conventional care; RCT: Randomized controlled trial; RH: Right hemicolectomy; LH: Left hemicolectomy; SB: Small bowel; AR: Anterior resection; IBD: Inflammatory bowel disease; Lap: Laparoscopic; LAR: Low anterior resection; APR: Abdominoperineal resection; Sig: Sigmoidectomy; ND: Not documented. Continuous data are given as median (range) or mean ± SD.

tional standard care instead of an early rehabilitation program. Only a few study results support the hypothesis that laparoscopic rectal surgery and a subsequent early rehabilitation program can act synergistically to enhance postoperative recovery and surgical outcomes.

During the past decade, some studies including prospective cohort studies and randomized controlled trials have shown that early rehabilitation programs enhance recovery after laparoscopic rectal resection and shorten the length of hospital stay[22-26]. However, these studies were heterogeneous: mixed open surgery or laparoscopy, colorectal disease or rectal disease, diverting stoma, and sphincter preservation, which makes it difficult to accept the validity of their results. Additionally, differences exist in the detailed components of individual early rehabilitation programs, which are classified into three categories of preoperative preparation, intraoperative intervention, and postoperative management, making it difficult to interpret a causal relationship between the components and positive/negative outcomes. To the best of our knowledge and based on the results of this literature review, only five studies have reported the results of implementation of early rehabilitation programs after laparoscopic rectal surgery: three prospective cohort studies[22,27,28], one retrospective case-control study[29] and one randomized controlled trial[30]. The characteristics of these studies are summarized in Table 2.

A prospective cohort study by Lindsetmo *et al*[22] reported the results of 37 patients undergoing laparoscopic rectal resection. The mean hospital stay was 3.0 d (range, 1-8 d), in which 90% of patients were discharged < 5 d after surgery. No anastomotic leaks or mortality occurred, and the in-hospital complication rate was 8% (1 surgical-site infection

Table 2 Summary of previous studies that evaluated early rehabilitation programs after laparoscopic rectal surgery

Ref.	Country	Study design	Inclusion period	Patients (*n*)	Operations	Clinical effectiveness (LOS and complications)
Lindsetmo *et al*[22], 2009	United States	Prospective cohort study	2005-2007	37 Cancer: 17 (46) Polyp: 4 (11) Others: 16 (43)	SPS: 37 (100) Diverting ileostomy: 7 (19)	Mean LOS: 3.0 d (range 1-8 d) Overall complications: 6 (16) UTI: 1; SSI: 2 Readmission < 30 d: 3 (8)
Chen *et al*[27], 2011	Taiwan	Prospective cohort study	2007-2009	80 Cancer: 76 (95) Benign: 4 (5)	APR: 15 (19) SPS: 65 (81) Diverting ileostomy: 32 (49)	Mean LOS: 5.0d (range 3-22) Overall complications: 11 (14) AL: 1; pelvic abscess 2; ileus: 1 Readmission < 30 d: 7 (9)
Stottmeier *et al*[28], 2012	Denmark	Prospective cohort study	2006-2009	102 Cancer: 102 (100)	APR: 19 (19) Hartmann: 6 (6) SPS: 77 (75) Diverting colostomy: 38 (37) Diverting ileostomy: 3 (3)	Median LOS: 5 d (range 2-42 d) Overall complications: 25 (25) AL: 3; intra-abdominal abscess: 3 Readmission < 30 d: 15 (15)
Huibers *et al*[29], 2012	Nether-lands	Retrospective case-control study	2004-2009	76 (ERP: 43, CC: 33) Cancer: 76 (100)	APR: 24 (32) ERP: 16 (37) CC: 8 (24) SPS: 52 (68) ERP: 27 (63) CC: 25 (76)	Median LOS: (P = 0.042) ERP: 7 d (range 2-83 d) CC: 10 d (range 4-74 d) Overall complications: ERP: 17 (40) AL: 5; intra-abdominal abscess: 7 CC: 9 (27) AL: 4; intra-abdominal abscess: 3 Readmission < 30 d: (P = 0.421) ERP: 5 (12) CC: 6 (18)
Lee *et al*[30], 2013	South Korea	RCT	2007-2011	98 (ERP: 52, CC: 46) Cancer 98 (100)	SPS: 98 (100) Diverting ileostomy: 98 (100)	Median recovery time[1]: (P = 0.47) ERP: 137 h (range 107-188 h) CC: 146.5 h (range 115-183 h) Overall complications: (P = 0.054) ERP: 22 (42) AL: 1; POI: 15; acute voiding difficulty: 9 CC: 11 (24) AL: 1; POI: 6; acute voiding difficulty: 2 Readmission < 30 d: 0 (0)

[1]Defined by tolerable diet for 24 h, safe ambulation, analgesic-free and afebrile without complication. LOS: Length of hospital stay; SPS: Sphincter preserving surgery; UTI: Urinary tract infection; SSI: Surgical site infection; APR: Abdominoperineal resection; AL: anastomosis leakage; ERP: Early rehabilitation program; CC: Conventional care; RCT: Randomized controlled trial; POI: Postoperative ileus.

and 1 urinary tract infection). Readmission was required in three patients (8%) because of medical illness. The authors suggested that laparoscopy in conjunction with modern perioperative care allows rapid recovery with efficient use of hospital resources.

In contrast, two cohort studies by Stottmeier *et al*[28] and Chen *et al*[27] highlighted that postoperative morbidity remains substantial after laparoscopic rectal surgery combined with early rehabilitation program, even though performed by experienced surgeons. Stottmeier *et al*[28] reported a median hospital stay of 5 d and a postoperative complication rate of 25% among 102 consecutive patients who had undergone elective fast-track laparoscopic rectal cancer surgery. Although about 40% of the patients had a diverting colostomy or ileostomy, reoperation was needed in 15% owing to anastomotic leakage, colonic ischemia, intra-abdominal abscess, or mechanical obstruction. Postoperative mortality (< 30 d) occurred in 3% of the patients; one with postoperative septicemia and pneumonia, one with postoperative multiorgan failure, and one with intraoperative splenic bleeding. Chen *et al*[27] calculated the success rate of their enhanced recovery program and reinvestigated factors that may have affected the results of the enhanced recovery program combined with laparoscopic rectal surgery. As designated by their program, patients were scheduled to be discharged on postoperative day 5. The criteria of discharge included absence of fever or tachycardia, successful passage of flatus or stool, tolerance of three meals per day, pain relief with oral nonopioid analgesics, and independent ambulation. They reported a success rate of 52.5%, and this failure was related to low rectal lesion sites (< 7 cm from the anal verge) and surgery-related complications, with a rate of 13.8%. The authors concluded that the enhanced recovery program for laparoscopic rectal surgery is feasible but is not advised for all cases requiring laparoscopic rectal surgery.

Previously, we had designed a prospective, randomized, controlled parallel group trial to compare the outcomes of an early rehabilitation program *vs* conventional care after laparoscopic low anterior resection in patients with mid-rectal or low rectal cancer (≤ 10 cm from the anal verge)[30]. The primary endpoint was recovery within 4 postoperative days and the criteria for recovery were as follows: tolerable diet for 24 h, safe ambulation, analgesic-

Table 3 Protocols used in previous studies for evaluating early rehabilitation programs after laparoscopic rectal surgery

Protocols	Lindsetmo *et al*[22], 2009	Chen *et al*[27], 2011	Stottmeier *et al*[28], 2012	Huibers *et al*[29], 2012	Lee *et al*[30], 2013
Preoperative stage					
General considerations	Patient education	Patient education and ERP explanation	Thorough information Establishing a contract	ND	Operative risk assessment Counseling, informed consent
Oral bowel preparation	Yes	Yes	No (enema for left-sided tumors)	No (2 enemas)	Yes
NPO	ND	8 h before surgery	Fluid until 2 h before surgery	2 h before surgery	8 h before surgery
Oral carbohydrate solution	No	No	No	Yes	No
Epidural analgesia	No	No	Yes	Yes	No
Prophylactic antibiotics	ND	Single dose	Single dose (ampicillin + metronidazole + gentamicin)	Single dose (cefalozine + metronidazole)	ND
DVT prophylaxis	ND	ND	LMWH 2 h before surgery Compression stockings	LMWH until discharge	ND
Perioperative stage					
Operation approach	Laparoscopic	Laparoscopic	Laparoscopic	Laparoscopic	Laparoscopic
Anesthesia	ND	Short-acting anesthetics	Propofol, remifentanyl and muscle relaxant	ND	ND
Fluid	ND	Perioperative fluid restriction	Avoid both hypovolemia and fluid overload	ND	ND
Urinary drainage	Urethral catheter	Urethral catheter	Suprapubic or urethral catheter	Urethral catheter	Urethral catheter
Nasogastric tube	Yes (orogastric tube, removed before extubation)	No	No	No	No
Intra-abdominal drain	Rarely	Yes	No	Yes (one)	Yes (one)
Postoperative stage					
Pain control	IV PCA (12-18 h) Ketorolac Oral analgesia	Oral NSAIDs immediately after surgery Opioid for 1 d if needed	Epidural analgesia Paracetamol, ibuprofen Opioid if needed	Epidural analgesia Paracetamol, diclofenac Opioid avoided	IV PCA till POD 2
Sipping water	Immediately after surgery	Immediately after surgery	Immediately after surgery	Immediately after surgery	Immediately after surgery
Oral food intake	POD 1	POD 1	Evening of the day of surgery	Liquid diet in the evening	Semi-fluid diet, POD 1
Removal of urinary catheter	POD 1	POD 1	Immediately after surgery	POD 2	POD 3
Removal of intra-abdominal drain	No drain	POD 4	No drain	POD 2	ND
Mobilization	As soon as possible	Immediately after surgery	Two hours after surgery	POD 1	POD 1
Regular laxatives	ND	Sennoside	MgSO4 1 g two dimes daily	MgO	MgO
Routine discharge	ND	POD 5	POD 3	ND	ND
Discharge criteria	Tolerance of fluids and solid diet, adequate oral analgesia, passage of flatus or stool, adequate home support	No fever, no tachycardia, successful passage of flatus/stool, tolerance for 3 meals/d, comfort in taking oral non-opioid analgesics, independent ambulation, adequate self-care ability	Adequate bladder and bowel function, ability to drink, eat, walk without problems, manageable pain	No remaining lines or catheters, toleration of solid food, passage of stool, controllable pain, self-care ability	ND (Recovery: tolerance of diet for 24 h, analgesic-free, safe ambulation, afebrile status without major complications)

ERP: Early rehabilitation program; DVT: Deep vein thrombosis; LMWH: Low-molecular-weight heparin; NSAID: Non-steroidal anti-inflammatory drug; PCA: Patient-controlled analgesia; POD: Postoperative day; ND: Not described.

free, and afebrile status without major complications. The sample size was based on a superiority design. All patients were between 20 and 80 years of age and had undergone temporary loop ileostomy with laparoscopic low anterior resection. Protocols for perioperative care programs and interventions were modified from previously described protocols for colonic surgery (Table 3). Ninety-eight patients were randomized on a 1:1 basis to an early rehabilitation or conventional care program. The recovery rates were no different in both groups; however, more com-

plications were observed in the rehabilitation program group (42.3% *vs* 24.0%, $P = 0.054$), which were related to postoperative ileus (28.8% *vs* 13.0%, $P = 0.057$), and acute voiding difficulty (19.6% *vs* 4.7%, $P = 0.032$). Our randomized trial did not show that an early rehabilitation program was beneficial after laparoscopic low anterior resection. These results support those of previous studies in that postoperative morbidity might be a major obstacle to the ERAS in rectal cancer surgery.

CURRENT EVIDENCE-BASED RECOMMENDATIONS FOR EARLY REHABILITATION AFTER RECTAL SURGERY

Consideration points for adopting early rehabilitation program in rectal surgery

For the successful application of early rehabilitation programs to patients undergoing laparoscopic rectal resection, we need to recognize that colon surgery is entirely different from rectal surgery, which requires a deep pelvic dissection and is frequently accompanied by higher complication rates, longer hospital stay, and associated with unique complications such as sexual dysfunction, urinary retention, and pelvic organ injury (*e.g.*, hypogastric nerves and ureters) not seen in intra-abdominal colonic resection. Compared with colonic segmental resection, rectal surgery has higher technical complexity, longer operative times, and use of retraction known to increase perioperative morbidity[8]. Therefore, previous studies involving early rehabilitation programs excluded patients undergoing rectal resection[1,3,4,8]. In some studies, the results of rectal resection were mixed in the overall analysis of the application of early rehabilitation program protocols[23,24,26,31].

The available guidelines for perioperative care in rectal surgery are currently limited[2,8]. Recently, guidelines for perioperative care in elective rectal surgery were published by the ERAS Society, which had also published colonic guidelines[8,16]. In these guidelines, the authors remarked that they specifically considered the application of ERAS principles to a special population of rectal resection patients, because of the differences between colonic and rectal surgery. Until now, ERAS Society recommendations seem to be the best evidence-based guidelines for each item of the perioperative treatment pathway. These recommendations were derived from extensive review of meta-analyses, randomized controlled trials, and large prospective cohorts. However, these guidelines are basically intended for open rectal surgery, and are not focused on laparoscopic surgery. ERAS Society recommendations assess the quality of evidence ("high", "moderate", "low", "very low"), and decide the strength of recommendations as follows: strong recommendations indicate that the panel is confident that the desirable effects of adherence to a recommendation outweigh the undesirable effects; and weak recommendations indicate that the desirable effects of adherence to a recommendation probably outweigh the undesirable effects, but the panel is less confident[8]. Many items in the recommendations are based on low or moderate level of evidence. Some items are recommended by a high level of evidence, such as prophylaxis against thromboembolism or preoperative bowel preparation; however, studies on these items are based on the results of patients undergoing open surgery or in a population undergoing both open and laparoscopic surgery. Specific validation for these items in patients undergoing laparoscopic rectal resection remains insufficient.

Currently, no early rehabilitation protocol perfectly fits all patients undergoing laparoscopic rectal surgery[2]. For each individual patient, these guidelines, which are suggestions on the basic concept for early rehabilitation, should be modified to optimize perioperative care, minimize postoperative morbidity, and improve overall patient outcomes.

Patient selection, counseling and risk assessment

The first step is selecting patients. Extensive discussion with candidate patients on the entire surgical procedure followed by early rehabilitation program may be the most important step. This step can give patients the best insight into the benefits and risks and motivate them to make an effort to enhance their recovery after surgery because the success of early rehabilitation is affected by the active participation of the enrolled patient[2]. Previous studies and guidelines recommended direct interview, leaflets, or multimedia as information-providing methods[8]. Generally, patients who are bedridden, severely malnourished, and with an American Society of Anesthesia (ASA) score ≥ 3, who are planning to receive emergency rectal surgery are excluded, and any healthy patients with ASA 1-2 are included[8,32]. It is also important to improve the patient's medical condition by correcting anemia, malnutrition, or hyperglycemia, and promoting cessation of smoking and alcohol consumption at least 4 wk before surgery[33].

Bowel preparation

Mechanical bowel preparation (MBP) is considered a necessary step before colorectal surgery, and it is believed to decrease the risk of infectious complications and anastomotic leakage. However, several studies, including large meta-analyses, showed no difference between the MBP and no MBP groups on infection rates or anastomotic leakage after colorectal surgery[8,34-36]. Some studies suggested that MBP increased dehydration and electrolyte imbalance[37]. On the contrary, a recent multicenter randomized trial showed that overall and infectious complications were higher in the no MBP group compared with the MBP group in patients undergoing low anterior resection. In this study, a non-significant trend to a two-fold higher risk of anastomotic leak (19% in no MBP *vs* 11% in MBP) was also observed[38]. Current guidelines support omitting MBP in colonic surgery but indicate insufficient evidence supporting this omission in rectal

surgery[8,39,40]. There has been no study on MBP efficacy in the context of early rehabilitation programs. The Society of American Gastrointestinal and Endoscopic Surgeons Guidelines comments that MBP may be helpful in laparoscopic colorectal surgery, because it can make laparoscopic colorectal manipulation easier[40]. Further studies comparing MBP with no MBP in patients undergoing laparoscopic rectal surgery are necessary.

Postoperative pain

Postoperative analgesia is critical to enhance patient recovery because it directly affects early ambulation and patients comfort. Postoperative analgesia requires a multimodal approach consisting of the collaboration of the patient, surgeon, nurse, anesthesiologist and pain specialist[2]. Patient-controlled opioid analgesia (PCA) usually shows satisfactory result after rectal surgery[41]. However, PCA has some side effects influencing early recovery of patients, such as nausea, vomiting, and prolongation of postoperative ileus as well as sedation and respiratory suppression[2].

Two recent guidelines recommended continuous epidural analgesia (CEA) for open rectal surgery during 48-72 h, with intravenous administration of lidocaine in view of the superior efficacy of pain relief compared with systemic opioids[2,8,42]. CEA has the benefit of delivering a combination of local and opioid analgesia directly to the dorsal horn of the spinal cord, thus providing pain relief without systemic opioid effects[43]. However, this method involves an invasive procedure for catheter insertion and has some side effects, including pruritus, urinary retention, and arterial hypotension[44]. Some authors have advocated CEA use in the context of early rehabilitation in patients without contraindications[45,46]. They have suggested that the superiority of CEA seems to be greatest in the first 2-3 d postoperatively, and thus, routine removal of CEA after 2 or 3 d postoperatively may be a useful strategy. Some studies have shown that, in laparoscopic approaches that use only several small incisions instead of a single, large vertical incision from the umbilicus down, continuous intravenous infusion of lidocaine or PCA, as alternatives for CEA, also provide good pain relief in the first 24 h with a similar time to return of bowel function or length of hospital stay[8,47].

Pelvic drainage

The use of pelvic drainage after low anterior resection has been a controversial issue in rectal surgery. Some surgeons still prefer insertion of a drain into the pelvic cavity to prevent bloody ascites and its adverse effect on anastomosis. Several randomized trials and meta-analyses have shown that the routine use of a pelvic drain does not affect the anastomotic leakage or overall complications[48-50]. However, the use of a drain should be considered in cases of clinical indications, such as high-risk individuals or suspicion of tenuous anastomosis[8].

Prevention of ileus

Prevention of postoperative ileus is a crucial element not only for success of early rehabilitation, but also postoperative morbidity, readmission, and overall outcomes. To promote bowel motility after abdominal surgery, several methods have been evaluated, including gum chewing, oral magnesium oxide, and bisacodyl suppositories[51-54]. These methods have been reported to reduce time to bowel movement by 1-2 d, but there was no effect in the length of hospital stay or overall outcomes. However, the association of these medications with anastomotic dehiscence has not been addressed in a randomized trial of sufficient size. Furthermore, anastomotic leakage and temporary stoma should be considered in the use of stimulant laxatives after rectal surgery. Ileostomy has been reported as an independent risk factor for postoperative ileus, which developed in 22.8% of patients[55]. Our previous randomized controlled trial to evaluate the efficacy of an early rehabilitation program after laparoscopic rectal surgery also indicated a similar result, showing that a rehabilitation program introducing an early oral diet could increase postoperative ileus. Thus, further studies are necessary[30].

CONCLUSION

Early rehabilitation combined with laparoscopic rectal surgery is a feasible alternative in some selected patients, but indications have not been established. Current evidence fails to support the safety of early rehabilitation combined with laparoscopic rectal surgery compared to that reported for laparoscopic colonic surgery. Long-term outcomes, which might be affected by postoperative complications, in patients with malignant disease are unknown after laparoscopic rectal surgery followed by an early rehabilitation program. More data from well-designed clinical trials should be accumulated for widening the adoption of early rehabilitation programs to patients undergoing laparoscopic rectal surgery.

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ISSN 1007-9327