Enhanced Recovery After Surgery is Feasible in Laparoscopic Low Anterior Resection for Rectal Cancer

Jeong Seon Jo, M.D., Soo Young Lee, M.D., Hun Jin Kim, M.D., Chang Hyun Kim, M.D., Young Jin Kim, M.D., Ph.D., Hyeong Rok Kim, M.D., Ph.D.

Department of Surgery, Chonnam National University Hwasun Hospital, Hwasun, Korea

Purpose: The aim of this study was to compare short-term outcomes in patients who underwent laparoscopic assisted low anterior resection for colorectal cancer. The patients received either conventional perioperative care or the Enhanced Recovery After Surgery (ERAS) procedural care.

Materials and Methods: A retrospective review was conducted in patients who underwent elective laparoscopic low anterior resection for colorectal cancer between May, 2011 and December, 2013. Patients were grouped and analyzed according to the perioperative care program of ERAS and conventional care.

Results: A total of 81 patients received care *via* the ERAS pathway and 230 patients received care via conventional pathway. There was no significant difference in postoperative morbidity rates ($P=0.381$). The post-operative morbidity rates were 30.9% and 25.2% in the ERAS and conventional groups. No significant difference in hospital stay (9.0 ± 6.8 vs. 8.6 ± 3.5 days; $P=0.575$) was observed between the 2 groups.

Conclusion: No short-term perioperative disadvantages were found for the ERAS program compared with the conventional perioperative care for colorectal cancer patients who underwent laparoscopic low anterior resection. (*Surg Metab Nutr* 2015;6:11-15)

Key Words: Enhanced recovery after surgery, Laparoscopic low anterior resection

INTRODUCTION

Surgical outcome of colorectal cancer treatment depend not only on good surgery and tumor biology, but also on optimal perioperative care. Colorectal resections are associated with an in hospital stay of 6 to 11 days and a complication rate of 15% to 20%. The Enhanced Recovery After Surgery (ERAS) program was developed to improve perioperative care in these patients.[1-3]

ERAS is a multimodal, perioperative management, and care pathway that aims to reduce the stress response to

surgery and optimize postoperative recovery.[4] ERAS was associated with improved short-term outcomes that included reduced length of stay, reduced morbidity, faster return of bowel function, earlier mobilization, and lower pain score.[5-10]

Minimally invasive surgery (MIS) has demonstrated superiority in recovery and complications rates, without affecting oncological results or overall and disease free survival.[11] There are reports from smaller study populations of decreased hospital stay with MIS rectal surgery managed with ERAS programs.[12] Therefore, the feasibility of ERAS programs in rectal MIS procedures, especially laparoscopic low anterior resection, needs further evaluation.

The aim of the present study was to evaluate the clinical relevance of the improved perioperative care by

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Correspondence to: Hyeong Rok Kim, Department of Surgery, Chonnam National University Hwasun Hospital and Medical School, 322 Seoyang-ro, Hwasun-eup, Hwasun-gun, Hwasun 519-763, Korea
Tel: +82-61-379-7643, Fax: +82-61-379-7661
E-mail: drkhr@chonnam.ac.kr

comparing the mortality, morbidity, and hospital stay in patients who underwent laparoscopic assisted low anterior resection for colorectal cancer and received either conventional or ERAS perioperative care.

MATERIALS AND METHODS

We retrospectively reviewed patients who underwent elective laparoscopic low anterior resection for colorectal cancer by 2 operators in our institution between May, 2011 and December, 2013. A total of 342 patients were identified. Patients with diverting ileostomy, open conversion, and abdominoperineal resection were excluded from the analysis. Because a diverting stoma has reduced morbidity for patients undergoing colorectal surgery to colorectal cancer,[13,14] we excluded patients undergoing diverting stoma in order to prevent its possible bias on morbidity. A total of 311 patients were analyzed.

Patients included in the study were treated perioperatively with either ERAS or the conventional pathway in defined order (Table 1). Patients received different perioperative care of conventional and ERAS programs according to an operator. An enhanced recovery protocol included early oral feeding, active ambulation, and early removal of urinary catheter and drainage tube. Thromboprophylaxis was performed with enoxaparin (Clexane 20 mg s.c.) for 3 days. TNM stage was defined after microscopic examination by pathologists according to the 6th edition of the American Joint Commission on Cancer (AJCC) TNM staging system. The length of stay defined as the time between the date of surgery and date of dis-

charge, was the primary end point. Discharge criteria include adequate pain control with or without oral analgesics, no nausea and tolerating to regular hospital diet, no clinical or radiologic sign of postoperative ileus, mobilization and self support as comparable to the preoperative level, and agreement of the patient above all. These discharge criteria were used in both pathways. Secondary outcomes were to evaluate postoperative morbidities including ileus, anastomotic leakage, wound infection, urinary retention, acute kidney injury, and pneumonia. Each morbidity was defined: ileus; No flatus, abdominal distension, nausea or vomiting which prevented oral intake or required therapeutic use of nasogastric tube; anastomotic leak, discharge of bowel content via the drain, wound, or abnormal orifice; wound infection, documented erythema, discharge requiring antibiotics treatment or wound dehiscence requiring closure; urinary retention, failure to pass urine requiring insertion of urinary catheter; pneumonia, production of purulent sputum with positive bacteriological cultures, with or without chest radiography changes or pyrexia or consolidation seen on chest radiograph; acute kidney injury, decreased urine production, quantified as less than 400 ml/day; and fluid and electrolyte imbalance.

Statistical analyses were performed with SPSS[®] version 21.0 (SPSS, Inc., Chicago IL) for Windows[®]. Analysis of the categorical variables was performed by chi-square test, and analysis of continuous variables was performed by student's *t*-test in order to investigate the differences between the 2 groups. Continuous values were expressed as the mean ± standard deviation. A value of $P < 0.05$ was

Table 1. Clinical pathway of laparoscopic low anterior resections

ERAS group		Conventional group
OP day	LMWH, compression stocking, warm blanket, antiemetics	Compression stocking, warm blanket, antiemetics
POD 1	LMWH, water feeding, soft diet, fluid: 1000 ml	NPO, fluid: 3000 ml,
POD 2	LMWH, soft diet, foley catheter removal fluid: 1000 ml	Water feeding, foley catheter removal fluid: 2000 ml
POD 3	Soft diet	Soft diet
POD 4	RHD, drain removal	Soft diet, drain removal
POD 5	RHD	RHD
POD 6	RHD	Discharge
POD 7	Discharge	

POD = postoperative days; OP = operation day; LMWH = low-molecular weight heparin; NPO = nothing per oral; RHD = regular hospital diet.

considered statistically significant.

RESULTS

A total of 81 patients were cared for *via* the ERAS pathway, and 230 patients were care for *via* the conventional pathway. The mean age was 63.1 ± 11.0 years (range, 34~83) in the ERAS group, and 65.4 ± 11.3 years (range, 35~83) in the conventional group. There was no significant difference between groups with regard to age, sex, ASA, stage, underlying diseases, and BMI. However, there was a difference in tumor level ($P=0.018$) between the 2 groups (Table 2).

The ERAS group had an earlier removal of the drain catheter (4.3 ± 2.2 vs. 5.5 ± 1.8 days; $P<0.0001$) and foley catheter (2.6 ± 1.5 vs. 3.2 ± 1.2 days; $P=0.001$) than the conventional group. There was no significant difference in hospital stay (9.0 ± 6.8 vs. 8.6 ± 3.5 days; $P=0.575$) be-

tween 2 groups (Table 3). One patient from the ERAS group died due to myocardial infarction. A reoperation was performed on 6 patients from the ERAS group, and 19 patients from the conventional group.

The post-operative morbidity rates in the ERAS and conventional groups were 30.9% and 25.2%, respectively. There was no significant difference in the postoperative morbidity rates ($P=0.381$) (Table 4). Postoperative ileus occurred in 6 patients from the ERAS group, and 15 patients from the conventional group. These patients were improved by conservative treatments. Anastomotic leakage occurred in 5 patients from the ERAS group, and 18 patients from the conventional group. Reoperation was performed in all patients with anastomotic leakage.

DISCUSSION

Our study results suggested that ERAS program was as-

Table 2. Baseline characteristics of patients according to the treatment arms

Variables	ERAS group (n=81)	Conventional group (n=230)	P-value
Age, mean $\pm$ SD	63.1 $\pm$ 11.0	65.4 $\pm$ 11.3	0.198
Sex, n (%)			0.266
Male	60 (74)	153 (66)	
Female	21 (26)	77 (34)	
BMI, mean $\pm$ SD	23.4 $\pm$ 3.1	23.8 $\pm$ 4.8	0.393
Underlying disease, n (%)			0.700
Hypertension	34 (42)	94 (41)	
DM	22 (27)	50 (22)	
Pulmonary disease	2 (2.5)	11 (4.8)	
Liver disease	2 (2.5)	6 (2.6)	
Tumor level, n (%)			0.018
Upper rectum	57 (70)	131 (57)	
Mid rectum	17 (21)	87 (38)	
Lower rectum	7 (9)	12 (5)	
ASA score, n (%)			0.641
1	19 (20)	45 (20)	
2	57 (76)	174 (75)	
3	5 (4)	11 (5)	
Operation type, n (%)			0.001
Low anterior resection	77 (95)	230 (100)	
Intersphincteric resection	4 (5)	0	
Operation time (min), mean $\pm$ SD	149.3 $\pm$ 42.6	146.3 $\pm$ 29.6	0.557
Stage (AJCC), n (%)			0.283
1	29 (36)	77 (33.5)	
2	16 (20)	67 (29)	
3	30 (37)	77 (33.5)	
4	6 (7)	9 (4)	
Neoadjuvant chemotherapy, n (%)			0.215
Yes	12 (15)	22 (10)	
No	69 (85)	208 (90)	

SD = standard deviation; BMI = body mass index; ASA = American Society of Anesthesiologists; AJCC = American Joint Committee on Cancer.

Table 3. Summary of clinical results according to the treatment arms

Variables	ERAS group (n=81)	Conventional group (n=230)	P-value
Day to passage of flatus, mean±SD	2.1±1.4	2.37±1.5	0.114
Day of drain removal, mean±SD	4.3±2.2	5.5±1.8	<0.0001
Day of foley catheter removal, mean±SD	2.6±1.5	3.2±1.2	0.001
Day of defecation, mean±SD	4.1±1.7	4.7±1.9	0.011
Hospital stay, mean±SD	9.0±6.8	8.6±3.5	0.575
Reoperation, n (%)	6 (7.4)	19 (8.3)	0.808
Readmission within 30 days, n (%)	2 (2.5)	5 (2.2)	0.878
Death within 30 days, n (%)	1 (1.2)	0 (0)	0.260

Table 4. Postoperative Morbidities according to the treatment arms

Complication classification	ERAS group (n=81)	Conventional group (n=230)	P-value
Any complication, n (%)	25 (30.9)	34 (25.2)	0.381
Ileus, n (%)	6 (7.4)	15 (6.5)	0.799
AKI, n (%)	2 (2.5)	2 (0.9)	0.279
Anastomotic leak, n (%)	5 (6.2)	18 (7.8)	0.806
Wound infection, n (%)	7 (8.6)	17 (7.4)	0.809
Urinary retention, n (%)	5 (6.3)	14 (6.1)	0.958
Pneumonia, n (%)	1 (1.2)	1 (0.4)	0.454

sociated with no increased complications in comparison with a conventional program.

A meta-analysis of 13 randomized controlled trials comparing ERAS and conventional care for various colorectal operations including colorectal cancer surgery revealed that patients under the care of ERAS had a shorter hospital stay by approximately 2.4 days.[15] ERAS shortened the length of hospital stay (LOS) in patients undergoing laparoscopic colorectal resection for colorectal cancer.[16–18] Our study on the other hand, showed that there was no difference in hospital stay (9.0 ± 6.8 vs. 8.6 ± 3.5 days; $P=0.575$) between 2 groups. We attributed our results to the lack of strict discharge criteria of our protocol. The optimal outcomes of ERAS were largely dependent on the compliance and adherence to the protocol.[19,20]

The discharge of patients was delayed due to personal reasons of economic circumstances, schedules, and preferences. Furthermore, operators did not strictly keep a discharge criteria. The delayed discharge of patients could affect the readmission within 30 days. Previous study reported that readmission rates in the ERAS and conventional group were 7.7% and 13.8%, respectively.[21] We found that readmission rates in the ERAS and conven-

tional group in our study were 2.5% and 2.2%, respectively.

It is likely that the combination of elements in ERAS favored an uncomplicated outcome after laparoscopic low anterior resection for colorectal surgery. There was no difference in terms of overall morbidity, reoperation rate, and mortality between the 2 groups. Recent studies also reported that there were no significant differences in postoperative complication rates between the 2 groups. [21,22]

The advantages of ERAS have been widely reported in various operations for colorectal diseases. ERAS is known to provide increased benefits to patients during the postoperative recovery period. However, the impact of such a program on the long-term oncological outcome of colorectal cancer surgery is lacking. Emerging evidence indicates that the application of ERAS to colon cancer surgery effectively inhibits the release of post-operative inflammatory cytokines and mediators, reduces perioperative stress and preserves the post-operative immune system.[23] Better preservation of host immunity is possibly related to greater anti-tumor activity and increased survival in advanced colon cancer.[24] Therefore, long-term studies on such a program in colorectal cancer are needed. ERAS has likely oncological benefit to colorectal

cancer patients, since it enhances patient's recovery, maintains integrity of the postoperative immune system, increases feasibility of postoperative chemotherapy, and shortens the time interval from surgery to chemotherapy.

There are several limitation in this study. First, this is an observational retrospective cohort study and as such suffers from the unavoidable selection biases. For example, each treatment arms were neither randomly assigned nor surgeons who participating study used both protocol. Second, the sample size is not enough to fully address some issues. Especially, the outcome of anastomotic leak after adopting ERAS could not defined clearly due to this limitation. We hope that future studies should be performed to elucidate this issue with more detail.

In conclusion, the ERAS program for patients who underwent laparoscopic low anterior resection was associated with no increased postoperative morbidities in comparison with a conventional program. The ERAS program was thus feasible for colorectal cancer patients who underwent laparoscopic low anterior resection.

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