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Original Article

Perioperative and Delayed Discharge Factors for Gastric and Rectal Cancer in a Perioperative Management Program

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Abstract : [Purpose] We aimed to clarify the differences between the gastric and rectal cancer groups in the perioperative period and to clarify the causes of perioperative program deviation among participants with prolonged hospital stays. [Subjects and Methods] We retrospectively enrolled 94 consecutive patients undergoing laparoscopic surgery for cancers and collected information on age, sex, height, disease, surgical procedure, and hospital stay. Preoperative and pre-discharge biochemical data, body composition, grip strength, and 6-minute walking distance were investigated. Cases deviating from the perioperative management program were investigated individually. Statistical analyses were performed using the χ^2 test and Welch's t-test for intra- and intergroup comparisons. [Results] In total, 58/94 patients met the inclusion criteria. We found statistically significant differences in biomarker levels, muscle mass, grip strength, and 6-minute walking distance. Similarly, we found 15 cases with a prolonged postoperative stay in the rectal cancer group, which were due to difficulty with stoma management instruction, adding central vein ports, drain removal, vacuum-assisted closure therapy, chemotherapy, and postoperative delirium. [Conclusion] We found differences between groups for length of hospital stay only. Prolongation of hospital stay among patients with rectal cancer was mainly due to difficulty with stoma management guidance.

Key Words: Cancer, Enhanced recovery after surgery, Delayed discharge

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1. INTRODUCTION

The number of cancer cases and deaths is increasing worldwide every year, and cancer is the leading cause of death in Japan[1]. Thus, the number of cancer surgeries is similarly increasing, and the importance of appropriate perioperative management and shortening of hospital stays is becoming increasingly important.

Enhanced recovery after surgery (ERAS) has been attracting medical and research attention[2]. ERAS is a postoperative recovery enhancement program for patients undergoing colorectal cancer surgery in Europe. It is an evidence-based program for patients undergoing colorectal surgery that aims to reduce the stress of surgery, enhance recovery, reduce postoperative complications, shorten hospital stays, improve safety, and save costs by implementing various perioperative management methods (termed elements) in a multidisciplinary manner[3-5]. The basic concepts of elements include thorough pain management, early weaning, non-restricted oral intake, and no food withdrawal. ERAS, also known as fast track surgery or an enforced multimodal rehabilitation program, has been widely practiced in Europe and the United States[6]. The effectiveness of ERAS programs has been studied both domestically and internationally[7-9].

In addition to colorectal cancer, the ERAS program has been used for the perioperative management of cancers at various sites (such as the stomach, liver, and esophagus), and its effectiveness has been reported in many studies[7,10-13]. Furthermore, it is reported to be effective in both laparotomy and laparoscopic surgery[14]. We introduced our ERAS program (a 5-day discharge program: 5DDP) for laparoscopic gastric and colorectal surgery at our medical center (Table 1). The 5DDP is a program aimed at discharge on the fifth postoperative day (at the earliest).

Table 1 Schedule of the five-day discharge program at our hospital.

	POD 1	POD 3	POD 4	POD 5–7
Numeric				Discharge criteria can be achieved.
Meals	Start liquid diet at noon		・Rice gruel (in half degrees) for breakfast ・Rice gruel (in seven degrees) at noon	Whole porridge
Activity	Allowed to walk in the ward		Free in the hospital	
Cleanliness		Shower permit		

POD: Postoperative day

Although the efficacy of ERAS has been reported, most of the reports on changes in biochemical tests, such as perioperative serum albumin (Alb) and C-reactive protein (CRP)[15, 16] and physical functions, such as 6-minute walking distance (6MWD), an index of exercise tolerance[17], due to the introduction of ERAS programs have been limited to studies of a few cancers[18,19]. Comparisons among cancer sites and individual examination of cases deviating from the program have rarely been conducted. By comparing the perioperative factors among cancer sites and examining the reasons for deviating from the program in individual cases by going back in time through the medical records, we believe that we can clarify the modifications and additions to the ERAS program content in response to the differences among cancer sites and create a program that is appropriate for each cancer site. In addition, we believe that there is novelty and usefulness in creating a program that is appropriate for each cancer site. Therefore, in this study, we compared the perioperative factors for 5DDP cases with gastric and colorectal cancers, which have a high incidence rate in Japan and for which ERAS has been introduced at our hospital, and examined individual cases of program deviation. In addition, colorectal cancer can be broadly classified into colon and rectal cancers, but their treatment methods and postoperative complications are different[20,21]. In particular, rectal cancer is characterized by its effect on reproductive and urinary organs, different from other gastrointestinal cancers. Therefore, we focused mainly on rectal cancer in the current study. We hypothesized that the 5DDP aims for a minimum postoperative discharge of 5 days for both gastric and rectal cancers, but because of the different surgical invasion, inflammation may delay the squad.

2. PARTICIPANTS AND METHODS

1. Subjects

We conducted a retrospective observational study among 94 patients who underwent surgery for gastric or rectal cancer under general anesthesia, laparoscopically, or on a standby basis at the Department of Gastrointestinal Surgery at our hospital from April 1, 2015 to March 31, 2017, and who underwent preoperative and perioperative rehabilitation. Among the 94 initial participants, those who were pregnant or could become pregnant, those who were judged by the physician to be unlikely to continue rehabilitation, those who had serious cardiac or pulmonary diseases, those who could not be assessed due to severe paralysis or fracture, and those who developed postoperative complications were excluded from the current study because they were deviations from the ERAS.

Perioperative rehabilitation comprised preoperative evaluation of physical functions, explanation of the postoperative rehabilitation program, respiratory training in preparation for postoperative complications, and exercise therapy to maintain physical functions. In the postoperative period, activities of daily living were expanded while teaching movements that took into consideration wound pain and the use of muscles around the drain insertion site after consulting with the attending physician about the progression of weaning. The stage of progression with respect to the patient's weaning was aimed at walking in the ward on the first postoperative day and walking in the hospital on the fourth postoperative day. Respiratory assistance and positional drainage were performed as required.

This study was conducted in accordance with the principles of the Declaration of Helsinki and with the utmost consideration of the human rights of all participants. All personal information that could identify the participants was removed and stored in an encoded form, and records containing personal information were stored in a locked cabinet. This study was approved by the ethics review committee at our university (Approval No. 17-Io-139), and all participants provided their written informed consent.

2. Methods

Information on age, sex, height, disease, surgical procedure, and postoperative hospital stay were retrospectively extracted from the participants' medical records. We investigated biochemical data (Alb, hemoglobin [Hb], and CRP), body composition (body weight, body mass index [BMI], body fat percentage, and muscle mass), grip strength, and 6MWD prior to surgery and at discharge. Measurements were taken prior to surgery (at the time of the first preoperative rehabilitation intervention) and following surgery (at the time of the rehabilitation intervention prior to discharge).

Body composition was measured using a body composition analyzer (Inner Scan 50V BC-622; Tanita Corporation, Tokyo, Japan). In consideration of diurnal variation, measurements were taken at the same time each day for all participants. A grip strength meter (Grip-D T.K.K. 5101, Takei Kiki Kogyo Co., Ltd., Japan) was used to measure grip strength. The maximum grip strength of the dominant hand was measured twice in a standing position with the right and left upper limbs hanging down to the side of the body, and the maximum value was adopted. The grip width was adjusted so that the proximal interphalangeal joint of the index finger was in 90° flexion. For the 6MWD, participants were instructed to walk as long as possible within 6 min in a rehabilitation room (40 m in each direction). Participants could take a break during the measurement and could stop at any time during the measurement.

To examine cases deviating from the ERAS program, those who could not be discharged on the seventh postoperative day were considered deviation cases. For the factor analysis of the deviation cases, we extracted factors that prevented participants from being discharged on an individual basis based on their electronic medical records.

For statistical processing, Welch's t-test was performed for biochemical data (Alb, Hb, and CRP), body composition (weight, BMI, body fat percentage, and muscle mass), grip strength, and 6MWD pre- and postoperatively in both the gastric and rectal cancer groups. Age, sex, postoperative hospital stay, and other perioperative variables were compared using the χ^2 test and Welch's t-test for intra- and intergroup comparisons. The Statistical Package for the Social Sciences (SPSS) version 25 (SPSS Inc., Chicago, IL, USA) was used for all statistical analyses. The statistical significance level was set at $p < 0.05$.

3. RESULTS

This study included 58 patients (36 in the gastric cancer group and 22 in the rectal cancer group) who met the inclusion criteria out of the 94 qualifying patients presenting at our medical center. Pre- and postoperative changes in 36 and 22 patients in the gastric and rectal cancer groups, respectively, are shown in Table 2. We observed statistically significant differences in Alb, Hb, CRP, 6MWD, and muscle mass in both groups within the preoperative and pre-discharge comparisons. There was a statistically significant difference in weight in the rectal cancer group only.

The results of the comparison between the gastric and rectal cancer groups are shown in Table 3. We observed statistically significant differences in postoperative hospital stay (10.3 ± 6.3 days in the gastric cancer group and 19.8 ± 13.2 days in the rectal cancer group) and CRP prior to discharge (5.8 ± 3.8 mg/L in the gastric cancer group and 3.9 ± 2.9 mg/L in the rectal cancer group).

Table 4 shows individual factors for cases deviating from the ERAS program in patients with rectal cancer with a prolonged postoperative hospital stay. There were 15 cases of deviation. The factors that prolonged the length of hospital stay for each patient, including overlapping factors, were as follows (Fig. 1): 14 patients required time for stoma management guidance, three required the addition of central vein ports, three required time for drain removal, two required vacuum-assisted closure therapy, one required postoperative chemotherapy, and one required treatment for postoperative delirium. Details of concerns delaying effective stoma management are presented in Table 5. The most common reasons for delayed acquisition were problems within manual techniques, such as cutting and applying. Table 2 Baseline medical and demographic information

Table 2 Baseline medical and demographic information

		Stomach cancer n = 36	Rectal cancer n = 22	p
Cancer stage	I	25	5	$p < 0.05^{\dagger}$
	II	7	5	$0.57^{\dagger}$
	III	3	10	$p < 0.05^{\dagger}$
	IV	1	2	$0.29^{\dagger}$
Age (year)		70.7 ± 9.7	65.3 ± 11.5	0.08^{*}
Weight (kg)		57.3 ± 12.6	55.7 ± 19.7	0.75^{*}
Body mass index (kg/m²)		23.6 ± 3.7	24.4 ± 4.8	0.27^{*}
Body fat percentage (%)		26.7 ± 10.4	30.2 ± 8.3	0.18^{*}
Muscle mass (kg)		42.2 ± 8.1	41.5 ± 11.9	0.84^{*}
Operative time (min)		321.8 ± 69.7	354.5 ± 74.0	0.10^{*}
Estimated blood loss (mL)		51.3 ± 99.9	196.8 ± 366.3	0.08^{*}
Postoperative hospital stay (day)		10.3 ± 6.3	19.8 ± 13.2	$p < 0.05^{*}$
Alb (g/dL)		4.0 ± 0.4	4.0 ± 0.4	0.91^{*}
Hb (g/dL)		13.0 ± 2.3	13.0 ± 2.2	0.98^{*}
CRP (mg/L)		0.5 ± 1.3	0.2 ± 0.5	0.24^{*}
6 MWD (min)		443.8 ± 103.0	454.5 ± 115.6	0.72^{*}

Alb, albumin; Hb, hemoglobin; CRP, C-reactive protein; 6 MWD, 6-minute waking distance
Descriptive statistics are presented as counts or means/standard deviations
†Chi-squared test, *Welch's t-test

Table 3 Comparison before and after surgery in each group

	Stomach cancer n = 36			Rectal cancer n = 22		
	preoperative	postoperative	p-value	preoperative	postoperative	p-value
Weight (kg)	57.3 ± 12.6	55.2 ± 13.3	0.57	59.0 ± 19.7	54.3 ± 17.3	$p < 0.05$
Body mass index (kg/m²)	23.6 ± 3.7	22.9 ± 4.4	0.67	23.6 ± 4.8	21.9 ± 4.5	0.31
Body fat percentage (%)	26.7 ± 10.4	26.3 ± 10.2	0.94	30.2 ± 8.3	27.3 ± 6.2	0.85
Muscle mass (kg)	42.2 ± 8.1	41.4 ± 7.3	$p < 0.05$	41.5 ± 11.9	37.2 ± 11.7	$p < 0.05$
Alb (g/dL)	4.0 ± 0.4	2.9 ± 0.3	$p < 0.05$	4.0 ± 0.4	2.9 ± 0.3	$p < 0.05$
Hb (g/dL)	13.0 ± 2.3	11.8 ± 1.7	$p < 0.05$	13.0 ± 2.2	11.1 ± 1.8	$p < 0.05$
CRP (mg/L)	0.5 ± 1.3	5.8 ± 3.8	$p < 0.05$	0.2 ± 0.5	3.9 ± 2.9	$p < 0.05$
6 MWD (m)	443.8 ± 103.0	351.6 ± 89.5	$p < 0.05$	454.5 ± 115.6	343.2 ± 119.6	$p < 0.05$

Alb, albumin; Hb, hemoglobin; CRP, C-reactive protei; 6 MWD, 6-minute waking distance
Descriptive statistics are presented as counts or means/standard deviations
*Welch's t-test

Table 4 Postoperative comparison between groups

	Stomach cancer n = 36	Rectal cancer n = 22	p
Weight (kg)	55.2 ± 13.3	54.3 ± 17.3	0.89
Body mass index (kg/m²)	22.9 ± 4.4	21.9 ± 4.5	0.57
Body fat percentage (%)	26.3 ± 10.2	27.3 ± 6.2	0.75
Muscle mass (kg)	41.4 ± 7.3	37.2 ± 11.7	0.40
Alb (g/dL)	2.9 ± 0.3	2.9 ± 0.3	0.87
Hb (g/dL)	11.8 ± 1.7	11.1 ± 1.8	0.13
CRP (mg/L)	5.8 ± 3.8	3.9 ± 2.9	$p < 0.05$
6 MWD (m)	351.6 ± 89.5	343.2 ± 119.6	0.70

Alb, albumin; Hb, hemoglobin; CRP, C-reactive protein; 6 MWD, 6-minute waking distance
Descriptive statistics are presented as counts or means/standard deviations
*Welch's t-test

Table 5 Reasons for delayed acquisition of stoma management for each case

Case	Reason
A	The person's son, who lived with him, was mentally retarded and could not cooperate.
B	It was difficult to apply while stretching the lower crease.
C	There was a problem with the cutting technique.
D	He was blind on the left side and had amblyopia on the right side. His wife has a job and was unable to instruct him effectively.
E	There was unstable cutting and attaching.
F	The cut was unstable.
G	Immediately after surgery, the patient was relatively passive, and his wife was the primary instructor.
H	The cut was unstable.
I	Although the cutting technique was good, the lamination was unstable.
J	He did not significantly interfere. His wife was the primary instructor.
K	He became restless, and it was difficult to teach him.
L	Unstable application.
M	Immediately after surgery, the patient was relatively passive, and his wife was the primary instructor.

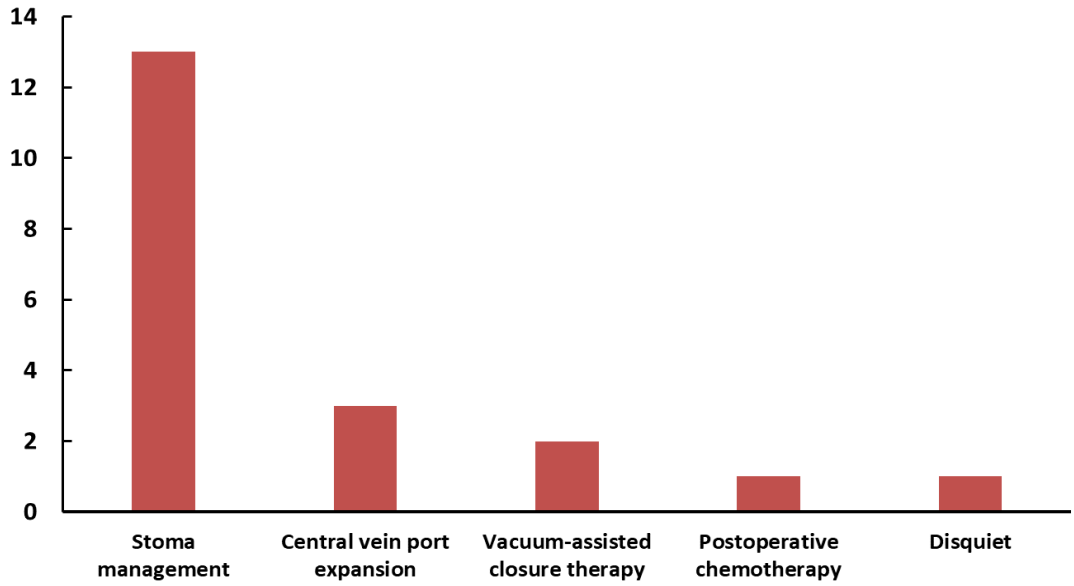

Figure1 Reason for prolonged postoperative hospital stay in rectal cancer patients

4. DISCUSSION

In the present study, we examined the differences in perioperative factors among participants who underwent laparoscopic surgery for gastric or rectal cancer as waitlisted patients and received perioperative management in our ERAS program. We also identified individual reasons why patients with longer hospital stays were removed from the ERAS program.

With respect to preoperative and pre-discharge changes, both groups showed lower Alb, lower Hb, and higher CRP levels, lower 6MWD, and lower muscle mass before discharge as compared to before surgery. The observed decrease in Alb and Hb levels and the increase in CRP levels may be due to bleeding and inflammation associated with surgical invasion. Surgical bleeding can be a factor in lowering Alb and Hb levels[22,23]. In addition, invasion associated with surgery may be the result of increased CRP[24] due to the body's immune response for repairing damaged cells and preventing pathogens from invading the body and increased vascular permeability (which results in exposure to Alb outside the blood vessels and decreased Alb synthesis) [25,26]. With respect to the observed decrease in muscle mass, the above results suggest that the immune response associated with surgical invasion has a substantial effect on skeletal muscle degradation and postoperative energy metabolism due to increased muscle protein catabolism[27]. In addition, muscle atrophy due to postoperative disuse syndrome is considered to be a contributing factor. However, in the ERAS program used in this study, patients were weaned starting from the first postoperative day. We thus believe that muscle atrophy due to disuse was minimized within the current intervention. Finally, the 6MWD is thought to have decreased due to the known effect of decreased muscle mass on performance, as shown in previous studies[28].

In the comparison between both groups, we found that there was a longer postoperative hospital stay and lower pre-discharge CRP in the rectal cancer group than in the gastric cancer group. There was no statistically significant difference in preoperative CRP levels between the gastric and rectal cancer groups, and the lower pre-discharge CRP observed in the rectal cancer group may reflect the fact that patients stayed in the hospital until their CRP levels decreased.

In the current study, we investigated the factors that caused patients to deviate from the ERAS program among those with rectal cancer with a longer postoperative hospital stay. The majority of these patients required more time for stoma management guidance, indicating the importance of stoma management guidance in reducing the length of hospital stay following rectal cancer surgery.

A stoma is an excretory opening created in the abdominal wall by surgery or other means. After rectal cancer surgery, a typical artificial anus is created as a gastrointestinal stoma when the rectum and anus are resected or when the colon is obstructed and the valve cannot pass through. With a stoma, the patient is unable to control his/her excretion voluntarily and must manage excretion by changing the orthotic. Compared to young or middle-aged adults, the elderly take more time to adapt to changes and have less hand dexterity. Thus, it takes more time for them to become independent in stoma care[29]. The stoma management technique involves many steps, such as cutting the faceplate according to the size of the stoma and applying it while looking in a mirror to prevent the skin from wrinkling, which can increase complications if not managed properly[30-32]. In addition, stomas have psychological effects, such as changes in body image, lowered self-esteem, and anxiety, and some are difficult to accept in a short period of time[33,34]. These factors are hypothesized to increase the length of hospital stay in some postoperative patients with rectal cancer, as patients with these struggles require more time to learn stoma management. The strength of this study is that it compared cancer patients from two locations and examined the reasons for delay, specifically for patients whose discharge was delayed. In addition, the results of this study showed that patients who underwent laparoscopic surgery for gastric and rectal cancers did not differ significantly in perioperative factors other than the length of hospital stay when using the same ERAS program. On the other hand, in patients with rectal cancer, the prolonged hospital stay was attributed to stoma management guidance. Although various efforts have been made regarding stoma management, such as preoperative guidance[35], consideration of educational materials[36], and psychological support[37],

it is necessary to examine methods that can bring about changes in a short period of time in accordance with the ERAS program.

Despite these strengths, the limitations of this study include the use of our own perioperative ERAS program, the retrospective nature of the study, and the fact that we did not conduct direct interviews when investigating ERAS deviation cases. In the future, we would like to discuss the impact of these limitations on the study results.

FUNDING and CONFLICT of INTEREST

No funding. The authors declare no conflicts of interest.

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