Changes in Physical Components after Gastrectomy for Adenocarcinoma of Stomach and Esophagogastric Junction

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ABSTRACT

Objective: Enhanced Recovery After Surgery (ERAS) is a multidisciplinary approach that aims to optimize perioperative management, promote postoperative recovery, reduce postoperative complications, and improve long-term survival. The current study aimed to evaluate and compare the postoperative physical activity after gastrectomy between patients who underwent upper gastrointestinal surgery according to ERAS and those who underwent surgery based on the conventional care (CC) protocol.

Materials and Methods: This prospective and retrospective review enrolled 60 patients (n = 31, ERAS group; n = 29, CC protocol group) diagnosed with adenocarcinoma of the stomach and esophagogastric junction who underwent curative surgical resection. Physical outcomes, including body weight, body mass index, body fat percentage, basal metabolic rate, muscle mass, gait speed, and handgrip strength at the preoperative and immediate postoperative periods and at 1, 3, and 6 months postoperatively, were compared between the ERAS and CC protocol groups.

Results: One month after surgery, the ERAS group had a lower percentage of body weight loss than the CC protocol group. There was no significant difference in terms of muscle mass loss between the two groups. The hand grip strength of the ERAS group increased after surgery. Further, at 1 month postoperatively, the gait speed of patients who underwent total gastrectomy in the ERAS group was significantly higher than that of patients in the CC protocol group.

Conclusion: ERAS for gastrectomy was associated with a lower percentage of weight loss and a trend toward physical activity enhancement in the early postoperative period.

Keywords: Enhanced Recovery after Surgery (ERAS); gastrectomy; physical change (Siriraj Med J 2023; 75: 266-274)

INTRODUCTION

Gastric cancer is the fifth most common malignancy worldwide, the tenth most prevalent in Thailand, and the third leading cause of cancer-related mortality.[1,2] Gastrectomy is the mainstay treatment of gastric cancer. It is a high-risk procedure and is associated with a high rate of perioperative complications.[3,4] After surgery, patients experience a decline in physical status, muscle mass (MM), and body weight (BW), which lead to poor quality of life and loss to follow-up.

Enhanced Recovery After Surgery (ERAS) is a multidisciplinary approach that aims to optimize

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perioperative management, promote postoperative recovery, reduce postoperative complications, and improve long-term survival. The ERAS guideline for gastric surgery was introduced in 2014.[5] Several studies have shown that the ERAS protocol is significantly associated with a lower length of hospital stay, enhanced bowel function, decreased hospitalization costs, and decreased rate of major postoperative complications.[6-9] In terms of long-term outcomes, compared with the conventional care (CC) protocol, ERAS was significantly associated with a better 5-year cancer-specific survival rate.[10] Further, it was correlated with a better postoperative physical activity and lower percentage of weight loss.[6,11] However, there are no available data about postoperative changes in physical compositions, such as BW and muscle function and strength, which are correlated with postoperative recovery.

Siriraj Hospital developed an intensive care program and established ERAS for patients undergoing upper gastrointestinal surgery.[12] The current study aimed to evaluate and compare postoperative physical activity after gastrectomy between patients who underwent upper gastrointestinal surgery based on ERAS and those who had surgery according to the CC protocol.

MATERIALS AND METHODS

Study design

This prospective and retrospective review included patients diagnosed with adenocarcinoma of the stomach and esophagogastric junction (EGJ) between September 2019 and February 2022 at the Faculty of Medicine Siriraj Hospital, Mahidol University. The eligibility criteria of this study were patients aged 18 years who were pathologically diagnosed with adenocarcinoma and who underwent curative surgical resection. Prior to surgery, all patients received information about ERAS and the CC protocol.[8,12] Patients with active cancer other than gastric cancer and EGJ cancer or those who were for palliative surgery were excluded. Conventional perioperative care was defined as normal perioperative management in which the treatment is dependent on individual surgeons and based on the experience and knowledge of the surgeon. However, all patients also received standard surgical therapy and routine surveillance.

The ERAS protocols involve therapeutic interventions in the preoperative, intraoperative, and postoperative periods. Patients and their families received preoperative counseling and education about treatment planning and preoperative preparation. The nutritional status was assessed and improved to achieve the target calorie intake. The energy requirement was 25-30 kcal/kg/day of total calories, and 1.5 g/kg/day of protein. Nutrition supplement was given to moderately malnourished patients. Patients with severe malnutrition received nutritional support at least 2 weeks before surgery. The enteral feeding tube was inserted in patients who could not tolerate adequate oral intake. To improve lung function and decrease postoperative pulmonary complications, patients were advised to smoke cessation at least 2 to 4 weeks prior to surgery and breathing exercise were encouraged preoperatively. In the perioperative period, patients received information about cough training and positioning. Patients were allowed to intake normal meals until 6 hours before the operation and intake clear liquid until 3 hours before the operation. Oral carbohydrate loading with 50 grams of glucose or SI-CARB Drink solution was administered to all non-diabetic patients 3 to 4 hours before surgery. Patients with gastric outlet obstruction underwent gastric decompression and lavage at least 3 days prior to surgery. Postoperative nausea and vomiting (PONV) risk was assessed, and nausea and vomiting prophylaxis was adopted. Intraoperative period, compression stockings were used for thromboembolism prophylaxis. The air-warming blanket was applied to prevent hypothermia. If the duration of the operation was longer than 4 hours or if the estimated blood loss was more than 500 ml, an additional dose of antibiotic was administered. An epidural or intravenous patient-controlled analgesia (PCA) was given to provide adequate postoperative pain control. We avoided the placement of a nasogastric tube and unnecessary external drain. On postoperative day (POD) 1, the patients were promoted immediate mobilization and allowed to sip water. The patients started to drink liquid on POD 2, then were allowed to ingest a low residual soft diet on POD 3. Perioperative glycemic control was performed. All drains were early removed when they were considered unnecessary. The aim of discharge was on the postoperative day 4 if they met the discharge criteria which included a normal body temperature, hemodynamic stability, adequate pain relief with oral analgesics, normal bowel movement, tolerance of soft diet, and normal white blood cell count. Our team contacted patients by telephone 48 to 72 hours after discharge for follow-up. Patients could contact us at any time if they had a problem.

Data on preoperative clinicopathological characteristics (including age, sex, tumor location, pathological stage, operative approach, and extent of resection) and physical factors (such as BW, body mass index [BMI], MM, hand grip strength [HGS], gait speed [GS], basal metabolic rate [BMR], and body fat percentage [%BF]) were reviewed. Body composition was analyzed using the bioelectrical impedance analyzer[13], which can provide information

about BW (kg), BMI (kg/m^2), MM (kg), %BF, and BMR (Kcal). HGS was measured using a handheld dynamometry, which can obtain information about muscle strength. The patients were asked to hold a dynamometer with the dominant hand in an upright straight position while the arms were in abduction at 15°, and then to squeeze the dynamometer with maximum isometric effort.[14] GS was evaluated using the 10-m walk test.[15] The patients walked with or without a walking device at a 10-m walkway without any break to the endpoint. The time required to perform two trials was converted to walking speed. GS was calculated as distance (m) divided by time (s). All data were collected at the immediate postoperative period and then at 1, 3, and 6 months postoperatively (Fig 1). The current study primarily aimed to evaluate and compare changes in BW, BMI, %BF, BMR, MM, GS, and handgrip strength after gastric surgery between the ERAS and CC protocol groups.

Gastric resection and lymphadenectomy were performed in accordance with the Japanese gastric cancer treatment guidelines.[16] Subtotal gastrectomy (SG) was defined as proximal gastrectomy and distal gastrectomy. Total gastrectomy (TG) was defined as TG and extended gastrectomy. This study was approved by the Institutional Review Broad of the Faculty of Medicine Siriraj Hospital, Mahidol University, Bangkok, Thailand (COA no. Si 557/2019).

Statistical analysis

All statistical analyses were performed using the Statistical Package for the Social Sciences software version 21.0 (SPSS, Inc., Chicago IL, USA). Continuous data were compared using the *t*-test and reported as mean ± standard deviation. Categorical data were analyzed using the Chi-square test and presented as number and percentage. A p-value of <0.05 was considered statistically significant.

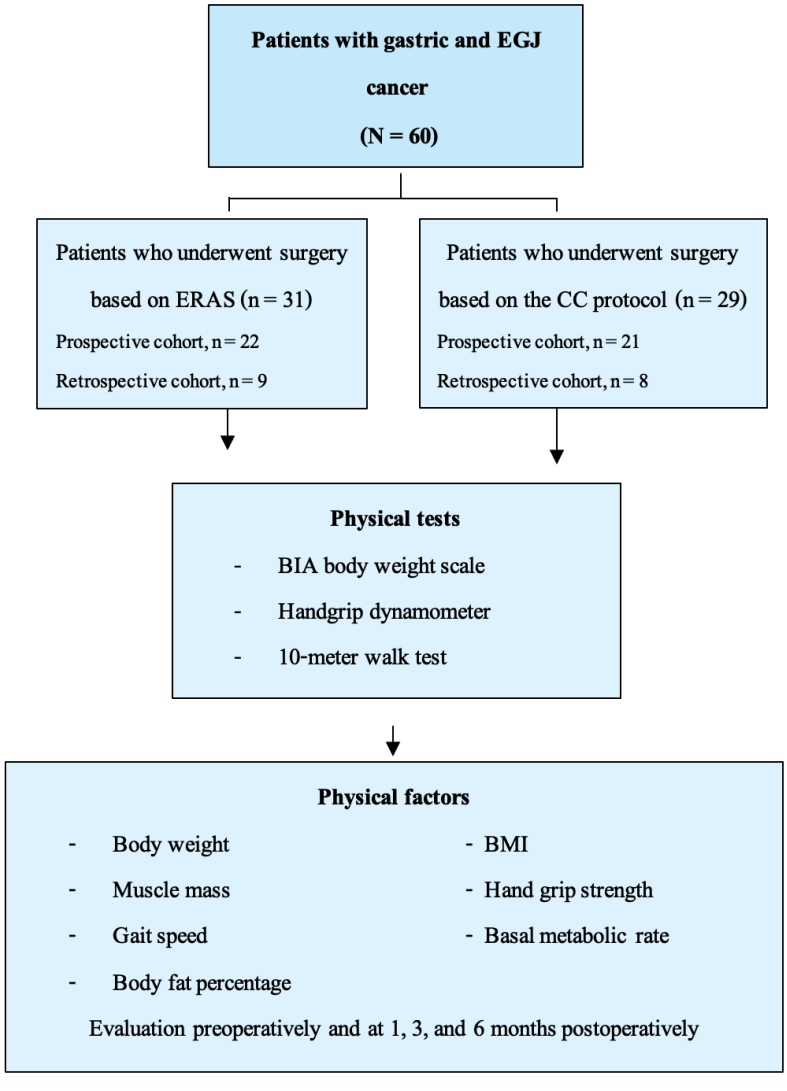

Fig 1. Study design and population

Abbreviations: EGJ, esophagogastric junction; n, number; ERAS, Enhanced Recovery after Surgery; CC, conventional care; BIA, bioelectrical impedance analysis; BMI, body mass index

RESULTS

The current study included 60 patients. Among them, 31 were enrolled in the ERAS group and 29 in the CC protocol group. The mean age of the participants was 63 years. Patients were diagnosed with adenocarcinoma of the stomach (n = 49, 81.67%) and EGJ (n = 11, 18.33%). There was no significant difference in terms of age, sex, tumor location, pathological staging, and operative approach. The proportion of patients who underwent TG was higher in the CC protocol group than in the ERAS group (p = 0.025). However, in the subgroup analysis, there was no significant difference in the extent of resection (Table 1) and baseline physical factors (BW, BMI, MM, HGS, GS, BMR, and %BF) (Table 2) between the CC protocol and ERAS groups.

Physical outcome

BW and BMI after gastrectomy decreased overtime in the CC protocol and ERAS groups (Figs 2 A–C). The ERAS group had a significantly lower percentage of BW loss (%BWL) at 1 month after surgery than the CC protocol group (6% vs. 9%, p = 0.036). Patients who underwent TG in the ERAS group had a significant lower %BWL than those who underwent TG in the CC group (5% vs. 9%, p = 0.043). There was no significant difference between the two groups in terms of %BWL at 3 and 6 months postoperatively. Moreover, both groups had lost MM overtime, and there was no significant difference in terms of changes in the percentage of MM (%MM) at 1, 3, and 6 months postoperatively (5.3% vs. 2.9%, p = 0.411; 4.5% vs. 7.2%, p = 0.618; and 6.5% vs. 11.7%, p = 0.450, respectively). The %BF loss did not significantly differ between the two groups. In the subgroup analysis, the %BF loss of patients who underwent TG in the ERAS group increased 6 months after surgery compared with that of patients who underwent TG in the CC protocol group (68% vs. 27%, p = 0.029) (Figs 2 D–F).

The BMR of the ERAS and CC protocol groups decreased after surgery. Further, there was no significant difference between the ERAS and CC protocol groups in terms of BMR at 1 month (65 vs. 62, p = 0.923), 3 months (91 vs. 112, p = 0.719), and 6 months (236 vs. 167, p = 0.244) postoperatively. The HGS (kg/BW) increased at 1, 3, and 6 months postoperatively in patients who underwent surgery based on ERAS (Fig 3A). However, in the TG subgroup analysis, there was no significant difference in terms of HGS at 1 month (0.002 vs. 0.02, p = 0.521), 3 months (0.11 vs. −0.68, p = 0.056), and 6 months (0.05 vs. −0.07, p = 0.252) postoperatively. The GS (m/s) of patients who underwent surgery based on ERAS increased at 1 month postoperatively (Figs 3B–C). There was no significant difference in terms of GS between the ERAS and CC protocol groups in all analyses (−0.69 vs. 0.14, p = 0.140). Nevertheless, the 1-month postoperative GS of patients who underwent TG in the ERAS group was significantly higher than that of patients who underwent surgery in the CC protocol group (−0.13 vs. 0.23, p = 0.018) (Figs 3D–F).

DISCUSSION

Previous studies have shown that ERAS for upper gastrointestinal surgery is beneficial in reducing length of hospital stay and promoting faster bowel function recovery.[6,17,18] Our study aimed to validate the application of ERAS based on its benefits in several aspects. Physical factors and body compositions can affect clinical outcomes in patients with cancer.[9,19] To validate the advantage of ERAS, we collected and compared data on muscle function performance and body composition between the ERAS and CC protocol groups. In terms of body compositions, this study found that after gastrectomy, the ERAS and CC groups had decreased BW, %BF, and MM. However, patients who underwent TG in the ERAS group had a lower %BWL at 1 month postoperatively compared with those who underwent TG in the CC protocol group. Our study result on BW change was in accordance with that of a previous study. A Japanese randomized controlled trial revealed that patients managed with ERAS had a lower %BWL. Further, the BW-to-preoperative weight ratio at 1 week and 1 month after surgery was higher in the ERAS group than in the CC protocol group.[6] Our previous prospective study[8] compared ERAS and the CC protocol in patients with upper gastrointestinal diseases who underwent curative resection at Siriraj Hospital. Results showed that BMI reduction was not significantly lower in the ERAS protocol group than in the CC protocol group. Nevertheless, the ERAS group had a faster BMI recovery than the CC group (3 vs. 6 months). In terms of MM and body fat loss, the ERAS group had a lower lean body mass loss (muscle and fat mass) than the CC group, probably due to the positive association between body mass and total %BWL.[20] Previous studies have shown that a lean BW loss of <5% at 1 month after surgery was an independent factor for predicting continuous treatment with adjuvant chemotherapy.[20]

HGS was strongly correlated with leg muscle power and calf cross-sectional muscle area. A low handgrip strength is a clinical marker of poor ambulation.[14] It has a linear association with inability to perform activities of daily living.[21] Our study has found that overall muscle strength (represented by HGS) and physical performance (indicated by GS) did not significantly differ between the

TABLE 1. Preoperative clinicopathological characteristics between the ERAS and conventional care groups.

Clinicopathological characteristics of the participants	Conventional care group (n = 29)	ERAS care group (n = 31)	P-value
Age, mean ± SD	63.76 ± 14.10	62.23 ± 13.48	0.669
Sex, n			0.170
Male	9 (31%)	15 (48.4%)	
Female	20 (69%)	16 (51.6%)	
Tumor location, n			0.379
Gastric cancer	25 (86.2%)	24 (77.4%)	
EGJ cancer	4 (13.8%)	7 (22.6%)	
pT stage, n			0.051
T0	1 (3.4%)	0 (0.0%)	
T1	5 (17.2%)	5 (16.1%)	
T2	6 (20.7%)	0 (0.0%)	
T3	7 (24.1%)	14 (45.2%)	
T4	10 (34.5%)	12 (38.7%)	
pN stage, n			0.170
N0	10 (34.5%)	10 (32.3%)	
N1	3 (10.3%)	8 (25.8%)	
N2	4 (13.8%)	7 (22.6%)	
N3	12 (41.4%)	6 (19.4%)	
pM stage, n			0.514
M0	27 (93.1%)	30 (96.8%)	
M1	2 (6.9%)	1 (3.2%)	
Operative approach, n			0.399
Open	25 (85.7%)	25 (80.6%)	
Laparoscopic	1 (3.4%)	4 (12.9%)	
Robotic-assisted	3 (10.3%)	2 (6.5%)	
Extent of surgery, n			0.025
Proximal gastrectomy	0 (0.0%)	4 (12.9%)	
Distal gastrectomy	7 (24.1%)	12 (38.7%)	
Total gastrectomy	16 (55.2%)	10 (32.3%)	
Extended gastrectomy	6 (20.7%)	5 (16.1%)	

A p-value<0.05 indicates statistical significance

Abbreviations: ERAS, Enhanced Recovery after Surgery; CC, conventional care; n, number; SD, standard deviation; n, number; EGJ, esophagogastric junction; pT, pathological primary tumor stage; pN, pathological lymph node stage; pM, pathological metastasis; Open, open surgery

TABLE 2. Preoperative physical factors compared between the ERAS and conventional care groups.

Physical factors	Conventional care group (n = 29)	ERAS care group (n = 31)	P-value
Body weight, mean ± SD	57.60 ± 10.74	60.13 ± 12.87	0.431
Body mass index, mean ± SD	22.57 ± 3.8	23.02 ± 4.33	0.687
Muscle mass, mean ± SD	39.61 ± 7.4	41.31 ± 8.11	0.597
Body fat percentage, mean ± SD	0.36 ± 0.12	0.39 ± 0.09	0.419
Hand grip strength, mean ± SD	0.76 ± 0.42	0.84 ± 0.26	0.586
Gait speed, mean ± SD	1205.22 ± 209.12	1328 ± 229.86	0.712
Basal metabolic rate, mean ± SD	30.42 ± 8.40	26.03 ± 12.13	0.336

A p-value<0.05 indicates statistical significance

Abbreviations: CC, conventional care; ERAS, Enhanced Recovery after Surgery; n, number; SD, standard deviation

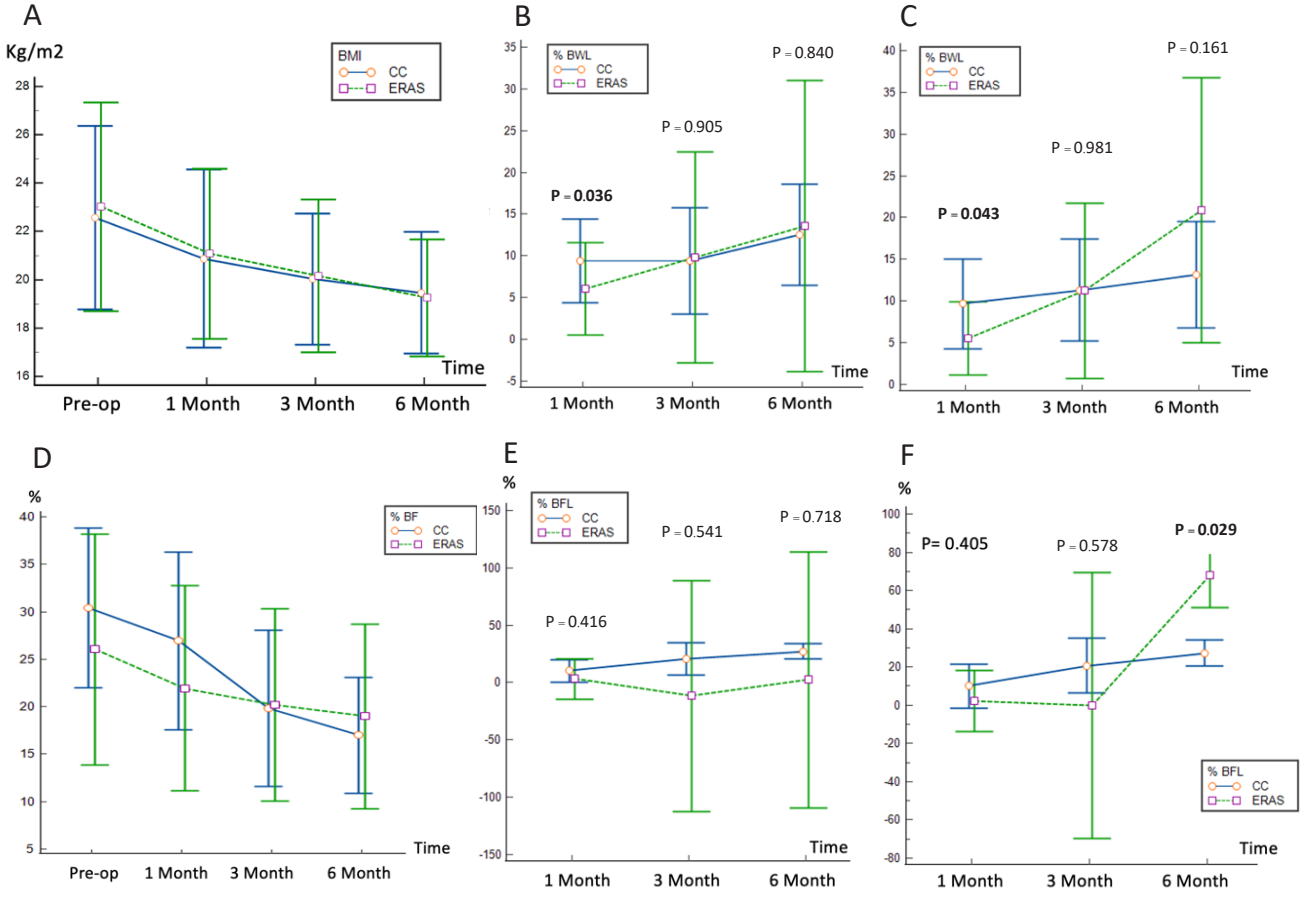

Fig 2. (A) BMI at the preoperative period and at 1, 3, and 6 months postoperatively, (B) % BWL in all group analyses, (C) % BWL in the total gastrectomy subgroup, (D) % BF at the preoperative period and at 1, 3, and 6 months postoperatively, (E) % BF loss in all group analyses, and (F) % BF loss in the total gastrectomy group

A p-value <0.05 indicates statistical significance

Abbreviations: CC, conventional care; ERAS, Enhanced Recovery after Surgery; BMI, body mass index; %BWL, percentage of body weight loss; % BF, percentage of body fat; %BFL, percentage of body fat loss; Pre-op, preoperative day

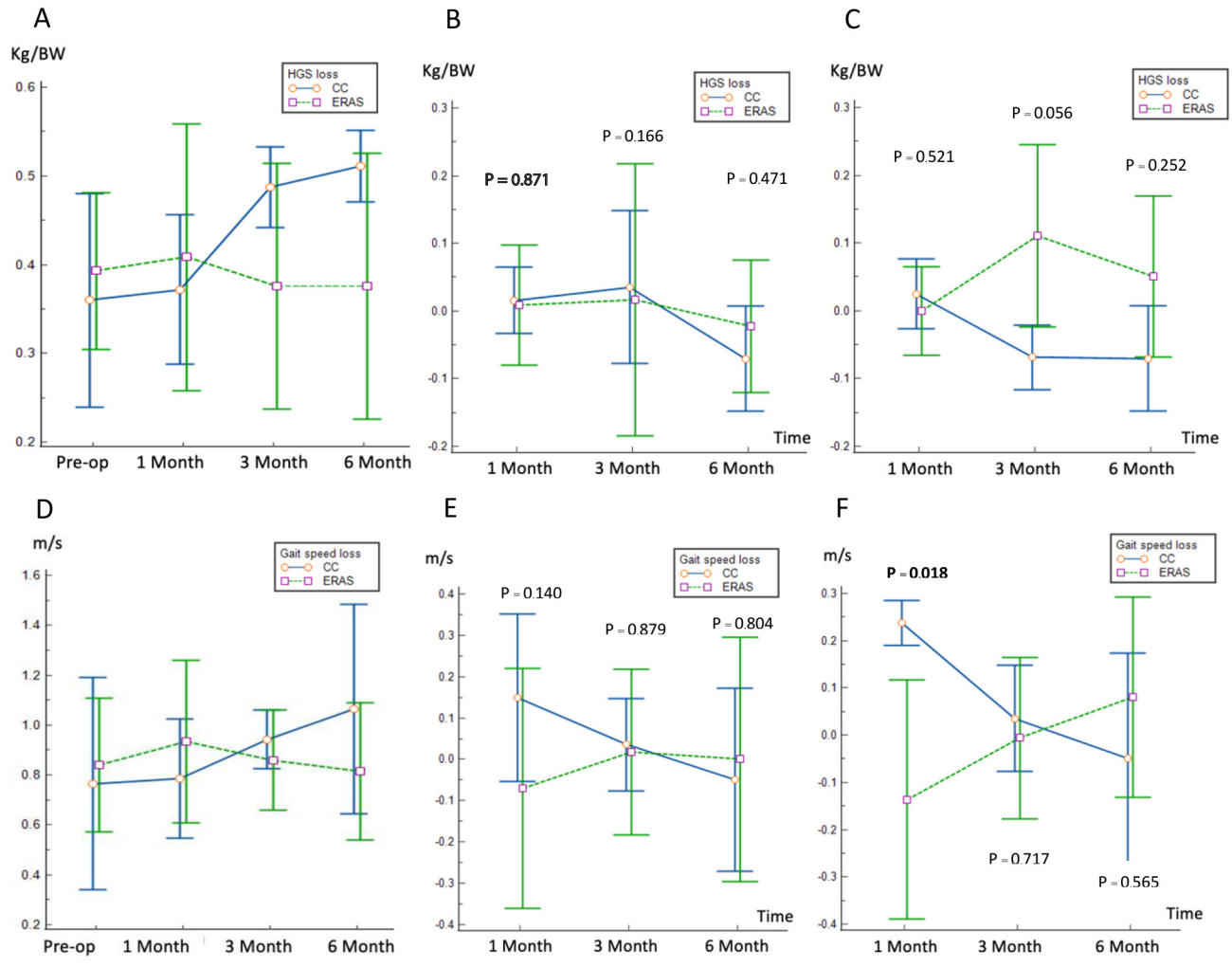

Fig 3. (A) HGS at the preoperative period and at 1, 3, and 6 months postoperatively, (B) HGS in all group analyses, (C) HGS in the total gastrectomy subgroup, (D) GS at the preoperative period and at 1, 3, and 6 months postoperatively, (E) GS loss in all group analyses, and (F) GS loss in the total gastrectomy subgroup

A p-value<0.05 indicates statistical significance

Abbreviations: CC, conventional care; ERAS, Enhanced Recovery after Surgery; HGS, hand grip strength; GS, gait speed; Pre-op, preoperative day

ERAS and CC groups. However, in the subgroup analysis of GS in patients who underwent gastrectomy, the ERAS group had a significantly better speed recovery at 1 month postoperatively than the CC group (0.13 vs. 0.23, p = 0.018). GS refers to physical performance.[22] Our data showed that the ERAS protocol promoted postoperative physical performance recovery. This finding was in accordance with that of another study[6] that facilitated more physical activities in the first week after surgery in the ERAS group.

Several clinical trials have shown that compared with surgery alone, adjuvant chemotherapy or chemoradiation therapy is associated with a better 5-year overall survival and 3-year disease-free survival.[23-25] There was a retrospective review about the long-term outcome of ERAS compared with the CC protocol. Results showed that the 5-year overall survival rates of the ERAS and CC protocol groups were 72.9% and 65.2%, respectively (p = 0.013).[10] Thus, the ERAS group had a better survival. Based on these data, the ERAS protocol had effects on BW and physical factors, and this could explain the association between ERAS and short- and long-term outcomes. Therefore, patients can receive adjuvant chemotherapy without delay, and this can contribute to improved survival.

This study has some mentionable limitations. First, our study cohort was small, and this might have limited the statistical power of our study in identifying all significant differences and associations. Second, there was variability in the surgical procedures. The majority of the conventional group underwent total gastrectomy which dominates the demographic data. The different types of gastrectomy and the reconstruction techniques

affected the post-operative condition. These were the factors that influence the nutritional status and post-gastrectomy sequence and affect this study. Therefore, further randomized controlled trials should be performed, and a larger sample size should be included to identify the benefits of ERAS.

CONCLUSION

ERAS for gastrectomy for adenocarcinoma of the stomach and EGJ can promote changes in physical compositions in the early postoperative period. Moreover, it is beneficial in reducing BW and promoting postoperative recovery.

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