Original article

Effect of patient-participation continuous nutritional counseling in gastric cancer patients who underwent gastrectomy

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Synopsis

Perioperative and post-discharge continuous nutritional counseling using patient's self-monitoring notebook was more effective than conventional management in preventing postoperative body weight loss and skeletal muscle loss in patients who underwent gastrectomy for gastric cancer.

Abstract

Background: Body weight loss (BWL) and skeletal muscle loss (SML) are inevitable after gastrectomy for gastric cancer (GC), and can decrease patients' quality of life (QOL) and survival. The aim of this retrospective study was to evaluate the effect of perioperative and post-discharge patient participation in continuous nutritional counseling (CNC) on post-gastrectomy BWL and SML.

Methods: Ninety-three patients with GC who underwent curative gastrectomy between March 2018 and July 2019 were analyzed. Patients received either pre-discharge nutritional counseling alone (control group, n=49) or patient-participation CNC (CNC group, n=44) after gastrectomy. Difference between percentage BWL (%BWL), percentage SML (%SML), and nutrition-related blood parameters between the preoperative values and those at 12 months after surgery were compared between the groups.

Results: Compared with the control group, %BWL was significantly lower in the CNC group at 1 month (–6.2±2.5% vs. –7.9±3.3%, p=0.005), 6 months (–7.8±6.6% vs. –12.3±6.4%, p=0.001) and 12 months (–7.9±7.6% vs. –13.2±8.2%, p=0.002); and %SML was significantly lower in the CNC group at 12 months (–5.3±10.3% vs. –12.8±12%, p=0.002). Regarding nutrition-related blood parameters, change in total cholesterol was significantly lower in the CNC group than the control group at 12 months after surgery (p=0.02). Multivariate analysis identified no CNC as an independent risk factor for severe BWL (p = 0.001) and SML (p = 0.006) at 12 months after surgery.

Conclusions: Following gastrectomy, patient-participation CNC prevented postoperative BWL and SML after surgery. These results support the induction of such a CNC program in these patients.

Key words: Gastric cancer, Gastrectomy, Body weight loss, Skeletal muscle loss, Nutritional counseling

Introduction

Despite the use of advanced modalities including chemotherapy and immunotherapy, gastrectomy with regional lymph node dissection remains the most effective curative treatment strategy for gastric cancer (GC) [1-3]. However, patients who undergo gastrectomy inevitably experience postoperative body weight loss (BWL) due to decreased stomach volume and impaired capacity of digestion and absorption [4, 5]. Patients who underwent distal gastrectomy (DG) have been reported to suffer BWL of 7.9%–8.9%, whereas those who underwent total gastrectomy (TG) had BWL of 13.8% [6, 7]. BWL after gastrectomy is associated with decreased quality of life (QOL), poor compliance of adjuvant chemotherapy and poor prognosis [8, 9]. Skeletal muscle loss (SML) and sarcopenia after gastrectomy have recently been reported as poor prognostic factors in patients with GC [10]. Although several studies have reported perioperative nutritional interventions using oral nutritional supplements (ONS) to suppress post-gastrectomy BWL, the efficacy of ONS is controversial [11-15].

Nutritional counseling by registered dietitians (RD) is considered to play an important role in post-gastrectomy patient management in terms of modification of dietary habits and coping with post-gastrectomy syndromes such as dumping syndrome. A recent systemic review showed that nutritional counseling for adults with disease-related malnutrition improved body weight, body composition, and QOL [16]. Moreover, nutritional support, including nutritional counseling, improved BWL in patients with gastrointestinal cancers [17]. However, the effect of nutritional counseling in patients who have undergone gastrectomy is unclear. Alterations to stomach capacity and function after gastrectomy require patients to change their eating habits, which is therefore the focus of nutritional counseling in these patients. The concept of patient participation in affecting health-related behavioral change is a core requisite in quality healthcare, and is defined as the active involvement of the patient in determining and monitoring their own care and treatment [18-20]. We introduced perioperative and post-discharge continuous nutritional counseling (CNC) to prevent postoperative BWL and SML) in

patients who had undergone gastrectomy, in which the patients recorded their body weight, food intake, stool, abdominal symptoms, and exercise daily, using a self-monitoring notebook.

The aim of the present retrospective study was to evaluate the effect of perioperative and post-discharge patient participation CNC on BWL and SML in patients who underwent gastrectomy.

Patients and Methods

Patients

We investigated 113 consecutive GC patients (Japanese) who underwent gastrectomy and were managed by the same clinical path during the perioperative period between March 2018 and July 2019 at Okayama University Hospital, Okayama, Japan. This study was approved by the Institutional Review Board of Okayama University Hospital (No. 2001-031).

Study Design

The patients were divided into two groups according to whether they received one session of pre-discharge nutritional counseling (control group); or both perioperative and post-discharge CNC (CNC group), which was introduced in January 2019. Perioperative and post-discharge CNC was performed a total of six times: before surgery, before discharge, and at postoperative months 1, 3, 6, and 12 after surgery (POM1, POM3, POM6, and POM12, respectively). (**Fig. S1**). Simultaneously, we introduced a self-monitoring notebook in which patients recorded their body weight, amount of food intake, walking step count, number of stools, and abdominal symptoms. They recorded these items daily, from the day after surgery to 1 month after surgery. All nutritional counseling was performed by RDs in sessions that lasted at least 30 min. In nutritional counseling before surgery, patients received orientation about post-gastrectomy syndromes and the necessity to change their eating habit after gastrectomy, and this advice was delivered once more prior to discharge. At the four outpatient nutritional

counseling sessions, which were personalized, the RDs asked about the patient's amount of food intake and abdominal symptoms and calculated their energy intake using food models. On this basis, they recommended a low-carb, protein-rich, and high-fat diet, and ONS was recommended for patients with insufficient energy intake. Body composition was analyzed using a bioimpedance device (InBody S10, InBody Japan, Tokyo, Japan) at each nutritional counseling session. We evaluated the effect of patient-participation continuous nutritional counseling on postoperative BWL, SML, and nutrition-related blood parameters, which were compared with the values obtained at the conventional pre-discharge CNC session.

Data collection

Patient demographics, clinical characteristics, surgical outcomes, pre- and postoperative body weight and amount of skeletal muscle, and homological and biochemical parameters were reviewed. The Charlson Comorbidity Index was used to evaluate preoperative comorbidity, a score of 1 or higher with the exclusion of the presence of GC as a comorbidity was defined as the presence of comorbidity [21]. Skeletal muscle area (SMA) was measured by CT as the total cross-sectional muscle area at the third lumbar vertebral level. Measurements of the muscle compartment in the range of –30 to 150 Hounsfield units were obtained preoperatively and at 6 and 12 months after surgery using the Synapse Vincent volume analyzer (Fujifilm Medical, Tokyo, Japan). Skeletal muscle index (SMI) was calculated as follows: SMA [cm^2] / (height [m] × height [m]). Sarcopenia was defined as a SMI value less than the sex-specific lowest quartile of SMI, with cut-off values for males and females of 41.5 and 33.9 cm^2/m^2, respectively. Postoperative complications were graded according to the Clavien–Dindo classification [22]. The pathological status of GC was classified based on the Japanese Classification of Gastric Carcinoma [23]. Percentage BWL (%BWL) and percentage SML (%SML) were defined as the ratio of the preoperative values to those at 1 year after gastrectomy, and were considered severe for values ≥10%. This cutoff value was chosen

because the mean %BWL and %SML values in the total 93 patients enrolled in the study at postoperative month (POM) 12 were 9.3% and 10.7%, respectively. Prognostic nutritional index (PNI) was calculated as 10 × serum albumin (g/dL) + 0.005 × total lymphocyte count (TLC) (mm^3). Ideal body weight (IBW) was defined as ideal body mass index (22 kg/m^2) × height squared (m^2).

Statistical analysis

The χ^2 test or Fisher's exact test was used to analyze categorical variables and Student's *t*-test or Wilcoxon signed-rank test was used to analyze continuous variables. Univariate and multivariate logistic regression analysis were performed to identify independent predictive factors for severe BWL and SML at 12 months after surgery. Categorical values that were evaluated as $p<0.20$ in the univariate analysis were adopted for the multivariate analysis. All *p* values were two-sided, and those less than 0.05 were considered statistically significant. Statistical analyses were performed using JMP software ver. 12.2 (SAS Institute, Cary, NC, USA).

Results

Patient characteristics

Between March 2018 and July 2019, 113 consecutive patients with primary GC underwent elective gastrectomy at Okayama University Hospital. Twenty patients were excluded from the study, for the reasons of non-curative resection (n = 2), lack of clinical data until 12 months after surgery (n = 14), and death within 12 months after surgery (n = 4). The final dataset population included in analysis comprised 49 patients in the control group and 44 in the CNC group (**Fig. 1**). **Table 1** lists patients' preoperative characteristics, nutrition-related blood parameters such as serum albumin, total cholesterol level, total lymphocyte counts and

PNI, body composition, tumor factors, and surgical outcomes. There were no significant differences between the groups for any factor.

Impact of CNC on postoperative BWL and SML

Percentage BWL was significantly lower in the CNC group than in the control group at POM1 (–6.2±2.5 vs. –7.9±3.3%, $p = 0.005$), at POM6 (–7.8±6.6% vs. –12.3±6.4%, $p = 0.001$), and at POM12 (–7.9±7.6% vs. –13.2±8.2%, $p = 0.002$) (**Fig. 2a**). Percentage SML was significantly lower in the CNC group than in the control group only at POM12 (–5.3±10.3% vs. –12.8±12%, $p=0.002$) (**Fig. 2b**). Regarding the development of sarcopenia, 12/38 (31.6%) patients in the control group who did not have preoperative sarcopenia developed sarcopenia at POM12, whereas only 6/32 (18.6%) patients in the CNC group developed sarcopenia postoperatively, but the difference between the groups was not significant ($p = 0.22$) (**Fig. S2**).

Risk factors for severe postoperative BWL and SML

Univariate and multivariate analyses identified TG (OR, 7.86; 95% CI, 1.50–64.1; $p = 0.01$) and no CNC (OR 0.22, 95% CI 0.08–0.55, $p = 0.001$) as independent risk factors for severe BWL at POM12 after gastrectomy (**Table 2**). TG (OR, 19.0; 95% CI, 2.93–387.4; $p < 0.001$) and no CNC (OR 0.27, 95% CI 0.10–0.69, $p = 0.006$) were also identified as independent risk factors for severe SML at POM12 after gastrectomy (**Table 3**).

Impact of CNC on hematological and biochemical parameters

No significant differences were observed between the groups concerning change in hematological and biochemical parameters at POM12 except for total cholesterol, which was significantly lower in the CNC group than the control group (–4.0±37.9 vs. –24.1±39.6, $p = 0.02$) (**Table 4**).

Changes in daily calorie and protein intakes and body composition in the CNC group

Daily calorie and protein intake per IBW gradually increased over the study period in the CNC group (**Fig. 3a**). Change of body composition in the CNC group over the study period is shown in **Fig. 3b**. Total fat mass decreased steadily to reach a plateau at POM6, whereas skeletal muscle mass decreased until POM3 and increased thereafter.

Discussion

The results of this study showed that CNC in GC patients who underwent gastrectomy prevented postoperative BWL and SML compared with conventional management of a single nutritional counseling session prior to discharge. Compared with the Control group, %BWL was significantly lower in the CNC group at 1, 6, and 12 months postoperatively. At POM1, %BWL was significantly less in the CNC group than the control group even though patients in the CNC group had received only one more preoperative nutritional counseling session by that time. Although the underlying reason for the difference is unclear, we speculate that it might be related to the induction of self-monitoring note and body composition measurement. The concept of patient participation, consisting of self-monitoring of dietary intake and physical activity, has a motivating effect on patients undergoing treatment and has been a major component of cognitive behavioral therapies for the control of body weight, especially in bariatric therapy [24, 25]. In the CNC group, 33/44 patients (75%) had completed their records in the self-monitoring notebook at POM1, and this relatively good adherence might have contributed to high patient motivation. In addition, the self-monitoring notebook also provided simple guidance regarding how to eat and the recommended foods after gastrectomy, which might have helped patients change their eating habits after gastrectomy.

Although several clinical trials have been performed to evaluate the benefits of nutritional interventions using ONS to prevent postoperative BWL in post-gastrectomy patients, the results have been inconsistent [11-15, 26]. The long-term outcomes are unclear, although

some studies have reported short-term effects of ONS on BWL at 2–3 months postoperatively. Kimura et al [12] have reported that nutritional intervention using an oral elemental diet prevented BWL at 1 year in patients who underwent TG. In the present study, TG and CNC were identified as independent risk factors for severe BWL at POM12. As TG is a well-known risk factor of BWL after gastrectomy, there has been a recent trend to avoid performing TG in patients with GC for this reason [27, 28]; however, TG is unavoidable in some patients. Feeding jejunostomy tube placement was sometimes performed for postoperative enteral nutrition in the patient performed TG with severe comorbidities and malnutrition. However, the efficacy of feeding jejunostomy tube placement in the patients underwent gastrectomy is controversial [29, 30], no patient has been performed this procedure during surgery in this study. ONS was recommended for the patients with insufficient energy intake at the nutritional counseling in CNC group. And although the presence of comorbidity, postoperative complication, preoperative chemotherapy and adjuvant chemotherapy were known to affect BWL and SML, these factors were not identified as independent risk factors for severe BWL and SML in this study. According to the European Society for Clinical Nutrition and Metabolism (ESPEN) guidelines, appropriate post-surgical nutritional support both before and after discharge from hospital is recommended for cancer patients at risk of malnutrition [31]. However, nutritional interventions using both ONS and CNC are required in patients at a risk of malnutrition, such as those undergoing TG. Several studies have investigated the effects of nutritional counseling for cancer patients undergoing radiotherapy or chemotherapy [32-34]. However, there are few reports regarding the effects of nutritional counseling on BWL in patients who have undergone gastrectomy. The present study is the first to show that CNC can prevent short-term and mid-term postoperative BWL in post-gastrectomy patients. It has been reported that it takes 3–6 months after gastrectomy to stabilize the food intake [11]. CNC can provide diet plans that are individually tailored to postoperative timing and personal dietary preferences, and additionally provide accurate dietary information for patients. These features of CNC enabled patients in the

CNC group to intake sufficient calorie and protein after discharge from hospital.

Sarcopenia, which had initially referred to the progressive systemic skeletal muscle loss that occurs with aging [35], has also been reported as a poor preoperative prognostic factor in several types of cancer, including GC [36-38]. Other recent studies have shown that postoperative SML is also a poor prognostic factor in several malignancies [10, 39]. The present study showed that %SML was significantly lower at POM12 in the CNC group than the control group. Moreover, multivariate analysis identified CNC as an independent risk factor related to severe SML and BWL at POM12. This result suggests that CNC after discharge from hospital may prevent both BWL and SML after gastrectomy. However, there was no significant reduction in the incidence of postoperative sarcopenia in the CNC group compared with the control group. Therefore, nutritional interventions using ONS in addition to CNC may be required in patients at risk of malnutrition, such as those undergoing TG, as has been suggested in previous studies [8, 12, 14].

This study has several limitations. First, this is a retrospective, single-center study, and included a small number of patients. A prospective randomized clinical trial (RCT) is needed to further evaluate whether CNC after discharge can prevent postoperative BWL and SML. However, it may be unethical to conduct a prospective RCT because we believe CNC for the patients following gastrectomy prevents postoperative BWL and SML. Second, there was a lack of data regarding total calorie and protein intakes in the control group because nutritional counseling after discharge was not performed in these patients. Therefore, we could not directly evaluate the effect of CNC on postoperative BWL and SML. Third, we evaluated only the short and mid-term effects of CNC on postoperative BWL and SML. The impact of CNC after discharge on long-term outcomes such as survival, skeletal muscle strength, and QOL should be investigated in future study.

Conclusions

Patient-participation CNC after discharge in patients who underwent gastrectomy for GC prevented BWL and SML at 12 months after surgery. These results support the induction of patient-participation CNC in these patients.

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None

Conflict of Interest

The authors declare that they have no conflict of interest.

Ethical standards

All procedures followed were in accordance with the standards of the Ethics Committee of Okayama University Hospital and with the Helsinki Declaration of 1964 and later versions.

Informed consent

Information about the aim of this retrospective study was posted on the website of the Department of Gastroenterological Surgery, Okayama University Hospital, and potential participants could decline to participate or opt out at any time.

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Figure legends

Fig. 1 Flow diagram of the study design.
GC, gastric cancer; CNC, continuous nutritional counseling; POM, postoperative month

Fig. 2 Postoperative change in body weight **(a)** and skeletal muscle **(b)** in the control and CNC groups.
%BWL, percentage of body weight loss; %SML, percentage of skeletal muscle loss; POM, postoperative month; CNC, continuous nutritional counseling

Fig. 3 Postoperative change in daily calorie and protein intake per IBW **(a)** and body composition **(b)** in the CNC group.
IBW, ideal body weight; POM, postoperative month; CNC, continuous nutritional counseling