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Case series

Effective and safe reduction in visceral fat using a formula diet in a short period before highly invasive endoscopic surgery – Case series

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ABSTRACT

Introduction: We retrospectively assessed the efficacy and safety of use of short-term formula diet therapy to achieve preoperative reduction in visceral fat immediately prior to highly invasive endoscopic surgery.
Presentation of case: We reviewed 5 cancer patients who underwent thoracoscopic and/or laparoscopic-assisted esophagectomy or gastrectomy. The cases were those with a BMI ≥30 kg/m^2 or waist circumference ≥100 cm. Patients replaced one meal out of the three main meals with one or two sachets of formula diet (170–340 kcal). The other two meals were set to 600 kcal. The dietary therapy was implemented approximately 1 month before the operation. Weight loss achieved after dietary therapy ranged from 6.4% to 14.1% ($p < 0.01$). With the exception of one case, the decrease in visceral fat area ranged from 17.0%–40.7% ($p = 0.03$). Postoperative complications were anastomotic insufficiency in two cases.
Discussion: Although the decreases of the visceral fat were effectively implemented, the adverse effects on postoperative complications must be examined in the farther study.
Conclusion: It was suggested that use of formula diet to achieve preoperative visceral fat reduction in a short period of time immediately prior to highly invasive endoscopic cancer surgery would be an effective and safe strategy.

1. Introduction

Several studies have demonstrated that visceral fat area (VFA) is a better parameter for evaluation of the difficulty of laparoscopic gastrectomy, the dissected number of lymph nodes, and the risk of postoperative complications [1–3]. In other studies, elevated VFA was associated with increased surgical complexity and postoperative morbidity [4,5]. In this setting, preoperative VF loss may confer several benefits including reduction in surgical complexity and the risk of postoperative complications. Many studies have reported the efficacy of a low-energy formula diet (FD) in achieving preoperative weight loss before bariatric surgery and laparoscopic gastrectomy [6–11].

In this study, we retrospectively reviewed the use of FD to achieve safely acceptable reduction in VFA as quantified by CT (Computed tomography), in a short period immediately prior to highly invasive surgery. This work has been reported in accordance with the Surgical Case Report (SCARE) guidelines [12].

2. Presentation of cases

Tables 1 and 2 show the characteristics and the diet schedules of patients. We investigated 5 cancer patients who underwent thoracoscopic and/or laparoscopic-assisted esophagectomy or gastrectomy between 2014 and 2020 in Suwa Red Cross Hospital. The surgeon was a gastrointestinal surgeon certified by the Japanese Society of Gastroenterological Surgery. The subjects were those with a BMI ≥30 kg/m^2 or waist circumference ≥100 cm and no nutritional problems. All patients underwent multislice spiral CT (Aquilion™ One, Canon Medical Systems Corporation, Tochigi, Japan) before the start of diet and immediately prior to surgery. A single cross-sectional scan at the level of the umbilicus was selected for quantification of VF. VFA was calculated by the software (Slim Vision®, KGT Corporation, Tokyo, Japan).

We opted for use of FD (Obe Cure®, USCure, Tokyo, Japan) to achieve weight loss. Patients replaced one meal out of the three main meals with one or two sachets of FD (170–340 kcal). The other two meals were set to usual diet in 600 kcal and no other intake of calories was allowed.

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Table 1
The characteristics and the diet schedules of cases.

Case	Age	Past history	BEEs (kcal)	Diet therapy period (days)	Calorie intake (breakfast-lunch-dinner) (kcal)	Dietary intervention
1	78	HT, HL, MI	1175	7 27	1140 (400-400-FD340) 1370 (600-600-FD170)	Before second surgery
2	55	HU	1435	37	1370 (600-600-FD170)	During chemotherapy
3	53	HT, HU	1312	14	1370 (600-600-FD170)	
4	69	HT, HL, DM	1863	37	1540 (600-600-FD340)	During chemotherapy
5	35		1606	30	1540 (600-FD340-600) 1370 (600-FD170-600)	During chemotherapy

HT, hypertension; HL, hyperlipidemia; MI, myocardial infarction; HU, hyperuricemia; DM, diabetes mellitus; BEEs, basal energy expenditure from standard weight; FD, formula diet.

Table 2
The clinicopathological characteristics and surgical procedures of cases.

Case	Carcinoma	cStage[a]	Surgical procedure
1	Esophageal ca	I, T1bN0M0	Two phase surgery 1.TSE, 2. LSER
2	Esophageal ca	III, T1bN2M0	TSE and LSER
3	EGJ ca	I, T1bN0M0	Laparoscopic-assisted abdominal esophagectomy and total gastrectomy
4	Esophageal ca	II, T1bN1M0	TSE and LSER
5	Esophageal ca	III, T3N1M0	TSE and LSER

Ca, cancer; EGJ, esophagogastric junction; TSE, thoracoscopic esophagectomy; LSER, laparoscopic-assisted esophageal reconstruction.
[a] UICC, TNM Classification of Malignant Tumors, 8 edition.

The calorie intake was set not to fall below the basal energy expenditure calculated from the individual standard weight. At the start, the patients and their spouses were provided dietary counseling by a nutritionist. The nutritional status of patients was assessed every 1 or 2 weeks based on the physical findings and investigation results to ensure safety of diet therapy. Nutritional parameters (total protein, albumin, transferrin, retinol binding protein, prealbumin) were measured to assess any excessive nutritional deficiency.

The purpose and safety of this study, possible disadvantages, patient anonymity and the fact that it can be rejected at any time during the study and will not be adversely affected, are fully explained for all the cases before participating in this study. And we got consent from them.

This study is a non-consecutive, retrospective study conducted in a single center.

All patients experienced no complications with no dissatisfaction with the dietary restrictions. Nutritional data measured just before and after the diet therapy are shown in Table 3. Data for all cases except case 5 were within the normal reference range. In case 5, prealbumin and retinol binding protein after dieting showed low values. There was no statistically significant difference between the data.

Table 4 shows the values quantified by CT. Weight loss resulting from diet therapy ranged from −6.4% to −14.1% ($p < 0.01$). The subcutaneous fat area decreased in all patients and the rate of decrease ranged from −13.1% to −23.8% ($p < 0.01$). With the exception of case 4, the decrease in VFA ranged from −17.0% to −40.7% ($p = 0.03$), which represented a much greater reduction compared to the decrease in subcutaneous fat.

Table 5 shows the details of the postoperative course. The operation time seems to be standard. Blood loss was somewhat higher (range, 100–450 g); however, massive bleeding of ≥500 mL was not observed. In case 4 and 5, these cases were extended in the hospital stay due to anastomotic insufficiency (Clavien-Dindo Classification IIIa). Other cases were discharged within the planned number of days.

3. Discussion

In a study, laparoscopic-assisted distal gastrectomy in obese patients was associated with more technical difficulties, longer operative time, and delayed recovery of bowel activity [13]. Other studies have reported a significant association between visceral obesity and increased postoperative serum levels of C-reactive protein [14,15]. As seen in case 1, patients with excessive body fat tend to have reduced muscle mass; this has a considerable influence on the postoperative cardiopulmonary function and physical activity.

The FD is rich in protein, vitamins, and minerals and deficient in energy-dense carbohydrates and fats. One sachet of Obe Cure® provides a total energy content of 170 kcal and contains 15 g carbohydrates, 22 g protein and 2 g fat. Our approach of FD replacement is based on the recommendations for diets in type 2 diabetes, as well as on the previously published reviews and meta-analysis [16,17]. In the setting of cancer surgery, extended time spent for achieving weight loss is typically not desirable; the efficacy and safety of short-term nutritional therapy to achieve weight loss in this setting has not been established.

It has been reported that diet therapy using FD could be effectively performed before laparoscopic gastrectomy [11]. The authors administered a diet with FD 20 days before surgery to patients with BMI ≥25 kg/m^2 or waist circumference ≥85 cm in men and ≥90 cm in women. In our study, we mainly targeted esophagectomy, which is more invasive than gastrectomy, and targeted BMI ≥30 kg/m^2. The above report only includes a few cases with BMI ≥30. Severe cardiopulmonary complications after esophagectomy, which can have fatal consequences especially in sarcopenic obese patients with reduced muscle mass, should be avoided at all costs. Focusing on the highly invasive esophagectomy and BMI ≥30, we examined whether a safe and effective diet can be achieved. In our study, a short-term diet resulted in a decrease in VF, and there was no preoperative malnutrition or postoperative

Table 3
The results of nutritional data.

Case	Total protein (g/dL)		Albumin (g/dL)		Transferrin (mg/dL)		Prealbumin (mg/dL)		Retinol binding protein (mg/dL)	
	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post
1	6.8	7.7	4.1	4.9	250	272	32.8	32.4	4.0	3.5
2	7.4	7.7	4.1	3.9	283	239	23.9	24.2	3.0	4.3
3	7.3	7.2	4.1	4.5	220	236	38.6	28.4	5.8	3.6
4	7.0	7.6	4.4	4.8	238	256	27.3	29.8	3.5	3.7
5	7.3	7.2	4.6	4.6	330	319	20.4	20.9	2.2	2.5
p		0.18		0.18		0.99		0.33		0.54

Pre, just before the diet therapy; post, just after the diet therapy; p, p value (*t*-test).

Table 4
The values quantified by CT.

Case	Weight (kg)		BMI (kg/m^2)		Waist circumference (cm)		Subcutaneous fat area (cm^2)		Visceral fat area (cm^2)	
	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post
1	73.0	66.0	27.1	24.5	103.4	94.5	161.5	140.4	153.6	95.7
Reduction (%)		−9.6		−9.6		−8.2		−13.1		−37.7
2	92.0	79.0	31.5	27.1	110.4	98.7	182.8	140.6	157.4	93.4
Reduction (%)		−14.1		−14.0		−10.6		−23.1		−40.7
3	84.0	78.6	32.1	30.0	105.0	92.8	293.5	229.7	131.8	84.6
Reduction (%)		−6.4		−6.5		−11.6		−21.7		−35.8
4	100.4	92.0	32.4	29.7	106.1	105.3	199.3	151.9	125.1	131.4
Reduction (%)		−8.4		−8.3		−0.8		−23.8		5.0
5	106	94.6	35.4	31.4	108.3	102.6	318.0	286.4	208.8	173.4
Reduction (%)		−10.8		−11.3		−5.2		−9.9		−17.0
p		<0.01		<0.01		0.02		<0.01		0.03

Pre, just before the diet therapy; post, just after the diet therapy; p, p value (t-test).

Table 5
The postoperative course.

Case	Operation time (min)	Blood loss (g)	Complication	Postoperative hospital stay (day)
1	300	250	None	21
2	610	450	Atelectasis	20
3	345	100	None	11
4	717	400	Anastomotic insufficiency (CDC IIIa)	79
5	577	100	Anastomotic insufficiency (CDC IIIa)	70

CDC: Clavien-Dindo Classification.

complications related to cardiopulmonary, and a safe and effective diet was possible. In case 3, effective weight loss was obtained in a short period of 14 days. In cases 2, 4 and 5, diet therapy was safely completed during preoperative chemotherapy. In our study, all patients exhibited a decrease in body weight and subcutaneous fat area. In addition, effective reduction of VF was observed in all but Case 4, which was unable to keep the prescribed diet. It is interesting to note that three patients experienced ≥35% reduction in VF, which was greater than the reduction in subcutaneous fat.

In this study, a VF loss rate of 5% to −40.7% was observed. Decreases in muscle tissue were also considered, and the effect of this on anastomosis cannot be ruled out. Previous papers have revealed that obesity was a risk factor for anastomotic insufficiency [18,19]. It is difficult to determine whether the anastomotic insufficiency in this study is due to diet or due to obesity. It should be emphasized that there were no more serious life-threatening cardiopulmonary complications.

The limitations of this study are that it is a single center, and the number of cases is small. The effect of reducing VF on surgical factors and complications could not be verified. Randomized control study is needed to verify the precise percentage of visceral fat loss that reduces surgical difficulty.

4. Conclusion

In conclusion, it was suggested that use of FD to achieve preoperative VF reduction in a short period of time immediately prior to highly invasive endoscopic cancer surgery may be an effective and safe strategy.

Consent

Written informed consent was obtained from all participants for purposes, benefits, risks and refusal in this study. Written consent to publish was obtained for the publication of all clinical details and images. A copy of the written consent is available for review by the Editor-in-Chief of this journal upon request.

Provenance and peer review

Not commissioned, externally peer-reviewed.

Ethical approval

This study was conducted in accordance with the Declaration of Helsinki and approved by the Ethics Committee in the Suwa Red Cross Hospital (No. 1-14).

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Guarantor

Kiyotomi Maruyama.

Research registration number

We have registered our research at University hospital Medical Information Network (UMIN) Center (https://www.umin.ac.jp/). The unique identifying number of our study is “UMIN000041824”.

CRediT authorship contribution statement

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Methodology	Kiyotomi Maruyama, Kou Shimada, Arano Makino
Validation	Kiyotomi Maruyama
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Data curation	Kiyotomi Maruyama, Kou Shimada, Arano Makino, Ryo Hisamune
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Declaration of competing interest

None.

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