

Case Report



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Conflict of Interest

The authors declare that they have no competing interests.

Nutritional Intervention for a Patient With Sleeve Gastrectomy

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ABSTRACT

Bariatric surgery is the most effective treatment for sustained weight reduction, and it can result in substantial improvements in the severity of type 2 diabetes, metabolic syndrome, nonalcoholic fatty liver disease, and quality of life. However, sleeve gastrectomy, a weight loss surgery that removes two-thirds of the stomach, reduces appetite and nutrient absorption, impairing digestion and the absorption of nutrients like iron, vitamin B₁₂, and protein-bound nutrients. This case study aims to demonstrate that patients undergoing sleeve gastrectomy require long-term and periodic monitoring of biochemical data, weight changes, and caloric and protein intake by a professional nutritionist to prevent malnutrition and nutritional deficiencies. In this case study, a 48-year-old woman was diagnosed with morbid obesity, hypertension, sleep apnea syndrome, and chronic gastritis. At initial evaluation, she was 160 cm tall and weighed 89 kg, with a body mass index of 34.8 kg/m². At 1 postoperative year, she consumed 650 kcal and 25 g of protein per day, the percentage of excess weight loss was 141.1%, and body mass index was 21 kg/m². Compared to preoperative levels, calcium and folic acid levels did not decrease after 1 postoperative year, but hemoglobin, ferritin, and vitamin B₁₂ levels decreased. In conclusion, when patients experience rapid weight loss after sleeve gastrectomy, follow-up should be frequent and long. Dietary education should be conducted according to digestive symptoms, and oral nutritional supplements, including vitamins and minerals.

Keywords: Sleeve gastrectomy; Nutrition; Nutritional intervention

INTRODUCTION

Obesity is a major public health issue that is reaching pandemic proportions. Bariatric surgery is the most effective strategy for steady weight reduction that can also mitigate the severity of type 2 diabetes, metabolic syndrome, nonalcoholic fatty liver disease, and quality of life [1].

According to guidelines, patients with body mass index (BMI) values ≥ 35 kg/m² (or ≥ 30 kg/m² with obesity-related comorbidities) are eligible for bariatric surgery [2]. Successful weight loss after bariatric surgery is determined by the percentage of excess weight loss (%EWL), and a loss of > 50% EWL after 2 years is generally considered to be a successful postoperative outcome [2].

Author Contributions

Conceptualization: Park S, Kim S; Data curation: Park S, Kim S; Investigation: Park S; Methodology: Park S, Kim S, Park Y; Project administration: Park S, Shin A; Resources: Park S, Shin A; Software: Park S, Shin A; Supervision: Park S, Park Y; Validation: Park S, Kim S; Visualization: Park S, Kim S; Writing - original draft: Park S, Kim S; Writing - review & editing: Park S, Shin A, Kim S, Park Y.

Sleeve gastrectomy consists of a calibrated longitudinal gastrectomy involving the removal of two-thirds of the stomach and leaving a volume of 75–100 mL [3]. It leads to neurohumoral changes due to decreased secretion of ghrelin, which results from removal of the gastric fundus, ultimately leading to appetite suppression and low nutritional intake [4]. Additionally, resection of the body of the stomach reduces mechanical digestion and acid secretion, impairing digestion and absorption of iron, vitamin B₁₂, and other protein-bound nutrients. Furthermore, mid-gastric stricture causing chronic vomiting could occur on a short-term basis [4]. Also, complications such as food intolerance may occur due to changes in gastrointestinal structure after surgery, and nutritional deficiencies may arise from the resultant decreased food intake [5]. The most common nutritional deficiencies in patients after bariatric surgery include deficiencies of iron, vitamin B₁₂, calcium, vitamin D, folic acid, copper, and zinc, in addition to poor caloric and protein intake. These nutritional deficiencies are common in patients with morbid obesity before and after surgery. Preoperative supplementation and long-term nutritional follow-up measures are required to prevent nutritional deficiencies [4,6].

In this case, we aim to show that patients undergoing sleeve gastrectomy require long-term and periodic monitoring of biochemical data, weight changes, and energy and protein intake by professional nutritionists to prevent malnutrition and nutritional deficiencies.

CASE

This study was approved by the Institutional Review Board of Seoul National University Bundang Hospital (B-2305-827-701). A 48-year-old woman was diagnosed with morbid obesity, hypertension, sleep apnea syndrome, and chronic gastritis. She was 160 cm tall and weighed 89 kg, with a BMI of 34.8 kg/m² at initial evaluation. The patient underwent sleeve gastrectomy in December 2020.

We collected biochemical, anthropometric, and food intake data (through interview and a meal diary) preoperatively, and then postoperatively after 1 day, 1 month, 3 months, 8 months, and 12 months. The patient's biochemical data before and after surgery are summarized in **Tables 1** and **2** shows changes in weight, % EWL, skeletal muscle mass, and percentage of body fat. Data summarizing intake of energy, protein, and vitamin supplements are shown in **Table 3**.

The nutritional interventions provided by clinical nutritionists for patients who underwent sleeve gastrectomy procedures at Seoul National University Bundang Hospital as shown in **Table 4**.

The patient's first screening visit for this case study was on November 16, 2020, which was about 2 weeks before surgery. The patient in this case consumed two meals a day before surgery and maintained a caloric intake of 1,800 kcal per day. The patient frequently ate snacks and had a preference for foods high in simple sugars and fat content. Preoperatively, we provided this patient with dietary education to limit calories to 1,000–1,200 kcal and 50–60 g of protein for 2 weeks prior to surgery, because preoperative weight loss reduces liver capacity and helps secure surgical vision [2]. This patient had lost 1.15 kg in about 2 weeks by following the education and restricting food intake.

Dietary education for gastrectomy was delivered to the patient on the first day after surgery during hospitalization and protein intake (1.2 g/kg; ideal body weight) was emphasized to

Table 1. Biochemical data before and after sleeve gastrectomy

Variables	2 weeks before surgery	Postoperative day	1 month after surgery	3 months after surgery	8 months after surgery	12 months after surgery
Albumin (g/dL)	4.5	-	3.8	4.2	3.8	4.1
Total protein (g/dL)	7.8	-	6.7	7	6.3	6.6
HbA1c (%)	6	-	5.6	-	5.3	4.6
TG (mg/dL)	124	-	104	-	60	91
LDL cholesterol (mg/dL)	162	-	105	-	95	107
HDL cholesterol (mg/dL)	86	-	47	-	59	67
Total cholesterol (mg/dL)	264	-	169	186	167	193
BUN (mg/dL)	17	-	9	16	11	10
Creatinine (mg/dL)	0.52	-	0.58	0.58	0.5	0.58
Calcium (mg/dL)	10	-	9.5	9.7	9.4	9.5
Phosphorus (mg/dL)	4.7	-	4.1	4	3.8	4.5
Glucose (mg/dL)	107	-	79	99	85	90
Uric acid (mg/dL)	5.2	-	8	4.2	3.7	4.6
AST (U/L)	31	-	21	24	18	22
ALT (U/L)	44	-	12	23	15	19
Hemoglobin (g/dL)	15.9	-	14.1	13.1	12.4	11.8
Hematocrit (%)	48.6	-	43	40.8	38.2	38.6
Vitamin B ₁₂ (pg/mL)	460	-	1,097	465	481	525
Ferritin (ng/mL)	60.6	-	202	75.9	26.6	28.6
Folate (ng/mL)	9.4	-	12.4	9.5	17.5	20
25-OH-Vitamin D ₃ (ng/mL)	12.5	-	-	-	22.1	26.3
PTH (pg/mL)	27	-	-	-	-	37

HbA1c, hemoglobin A1c; TG, triglyceride; LDL, low-density cholesterol; HDL, high-density cholesterol; BUN, blood urea nitrogen; AST, aspartate transaminase; ALT, alanine transaminase; PTH, parathyroid hormone.

Table 2. Anthropometric data before and after sleeve gastrectomy

Characteristics	2 weeks before surgery	Postoperative day	1 month after surgery	3 months after surgery	8 months after surgery	12 months after surgery
Height (cm)	160	-	-	-	-	-
Weight (kg)	89	87.85	73.8	68.1	59.5	54.2
Body mass index (kg/m ²)	34.8	34.3	28.8	26.6	23.2	21.2
Skeletal muscle mass (kg)	26.2	-	22.3	23.7	23.4	23.5
Percentage of body fat (%)	46.2	-	35.3	19.0	19.1	21.7
% EWL (%)*	-	-	58.9	82.8	118.9	141.1

*% EWL = Weight loss/Excess weight*100, Excess weight = Total weight per bariatric surgery – Ideal weight.

Table 3. Nutritional intake before and after sleeve gastrectomy

Nutritional intakes	2 weeks before surgery	Postoperative day	1 month after surgery	3 months after surgery	8 months after surgery	12 months after surgery
Energy (kcal/d)	1,800	-	620	900	500	650
Protein (g/d)	50	-	90	105	60	25
Multivitamin supplement	-	-	Taken	Taken	Taken	Taken
Vitamin D supplement	-	-	Taken	Taken	Taken	Taken

prevent muscle loss. Then, we educated the patient to aim for 500–700 kcal per day for a period of 1 to 2 months after surgery [9] and explained that the final goal was 1,000–1,400 kcal per day. In addition, the patients were instructed to take vitamin B₁₂, calcium, and iron supplements along with a multivitamin (chewed or multivitamin solution) that meets or exceeds 100% of the Korean Dietary Reference Intakes (KDRI).

At the time of outpatient consultation by the time of 1 month after surgery, intake was analyzed to be 620 kcal and 90 g of protein and %EWL was 82.8%. The patient was mainly taking full liquid diet and protein powder. Thus, we recommended the patient to take porridge diet and protein foods such as egg and tofu and encouraged to start strength training. At 3 months after surgery, she took three meals a day and protein powder was still being consumed, with 900 kcal

Table 4. Diet progression at Seoul National University Bundang Hospital

Stage	Dietary period	Dietary form	Recommendation
Stage I	1 week before surgery		<ul style="list-style-type: none"> • Energy: low-calorie diet of 1,200 kcal • Protein: 60 g/d
Stage II	The day after surgery	Try sips of water	<ul style="list-style-type: none"> • Chew small amounts of water
Stage III	1 week after surgery	Full liquid diet with protein powder	<ul style="list-style-type: none"> • Maintain small meals for 6–9 times a day • Chew small bites of food prior to swallowing • Intake of protein powder and multivitamin (liquid, chewable)
Stage IV	1–2 weeks after surgery	Full liquid diet with protein powder + protein snacks	<ul style="list-style-type: none"> • Intake of protein food (egg, tofu) • Soymilk, yogurt can be consumed
Stage V	2–6 weeks after surgery	Puree(porridge)/Soft liquid diet	<ul style="list-style-type: none"> • Energy: 500–700 kcal • Protein: 60–80 g/d or 1.2 g/kg • Chewing and ingesting longer than full liquid diet • Increased protein intake (fish, meat + protein powder) • Meals for 3 times a day
Stage VI	6 weeks after surgery	Normal diet	<ul style="list-style-type: none"> • Energy: 1,000–1,400 kcal • Protein: 60–80 g/d or 1.2 g/kg • Emphasizes lean protein (+protein powder) • Avoid carbonated beverage, alcohol and caffeine • Intake of whole grains & red pepper powder • Monitoring for vomiting & dumping syndrome

intake and 105 g of protein per day. We advised her to increase the calorie intake to 1,200 kcal per day and recommended 60-70 g of protein intake (such as meat, fish, and protein powder) per day. At 8 months after surgery, she had 2 to 3 meals per day due to decreased appetite, resulting in a daily intake of 500 kcal and 60 g of protein, with reduced consumption of protein-rich foods and vegetables. %EWL was 118.9% and BMI decreased by 23 kg/m². We recommended to increase food intake to 1,200 kcal per day through meals and snacks for 6 to 9 times and oral nutrition supplement was used. At 12 months after surgery, she only took two meals a day, each meal containing only 1/3 bowl of rice and 40 g of protein food and she ate snacks such as fruits and ionic beverages. Thus, 650 kcal and 25 g of protein were consumed per day, the %EWL was 141.1% and the BMI was 21 kg/m². The patient did not experience symptoms such as vomiting or early satiety, but due to decreased appetite, her food intake was extremely low. We encouraged her to eat a variety of foods to stimulate her appetite and advised her to consume oral nutrition supplements rather than low-calorie snacks, such as fruits or beverages.

Multivitamins and vitamin D supplements were continuously taken after surgery. We recommended her to continue taking them.

DISCUSSION

According to a report, the %EWL after sleeve gastrectomy was 59.3% at 1 year, 59.0% at 2 years, 54.7% at 3 years, 52.3% at 4 years, and 50.6% at 5 years [7]. Other studies have also reported that about 60% of EWL is observed 2 years after sleeve resection [8,9]. The classification of success in bariatric surgery necessary or sufficient for clinically significant change is commonly set at %EWL of more than 50% [10]. However, the %EWL result of this patient is 141.1%. Although this is a case of successful weight loss, continuous monitoring is required because there are many reports that regain occurs 2 to 5 years after surgery [11] and there is a high risk of malnutrition due to continuous weight loss.

While bariatric surgery brings about many positive clinical benefits such as improvement of diabetes and hypertension, the bariatric surgery limits food intake and it is likely to cause

food intolerance with symptoms like nausea, regurgitation, and vomiting [12]. According to other studies, vomiting, bloating, feeling gassy, eating too much and too fast, reduced social life, and loss of interest in food are reasons for low eating satisfaction after bariatric surgery [6,8]. One study reported a gradual increase in intake up to 748 kcal at 1 month, 943 kcal at 3 months, 1,005 kcal at 6 months, and 1,204 kcal at 1 year after sleeve gastrectomy [13]. Yue et al. [6] also noted that the patients after bariatric surgery showed an approximate daily energy intake of 570 kcal 1 month after operation and a gradual rise in energy intake to 731 kcal 3 months after bariatric surgery. However, although this patient's intake temporarily increased up to 900 kcal per day 3 months after surgery, she maintained an insufficient calorie intake of less than 700 kcal after 8 to 12 months. Vanoh et al. [14] also reported the Malaysian patients found that the mean energy intake was only 562 kcal per day 3 months after bariatric surgery. Therefore, in order to gradually increase intake, oral nutrition supplement should be used to increase caloric intake and periodic monitoring should be conducted.

Although some studies recommend only taking 45–58 g of protein per day to prevent malnutrition [15], according to the guideline, protein intake of 60–80g per day is recommended to prevent muscle atrophy, asthenia, hair loss, and anemia after bariatric surgery [2]. One study recommended an increase in protein intake to 41g at 3 months after surgery [6] and another study recommended an increase in protein intake to 60 g at 1 year after surgery [13]. This patient also maintained a protein intake of 60 g or more per day until the 8 months after surgery, but it was reduced to 25 g per day on the 12 months due to loss of interest in food. This indicates that the frequent monitoring and a follow up after 1 year are required. Many patients develop an intolerance to protein-rich food following bariatric surgery owing to factors such as smaller stomach size, altered gut anatomy and change in bilio-pancreatic function which lead to poor protein digestion and absorption [4]. Therefore, some patients may need to use protein supplements to meet the requirements after bariatric surgery. Also, for better dietary compliance, patients were advised to engage with a bariatric-trained nutritionist before and after bariatric surgery for an individualized dietary plan and guidance [15].

Gastric resection of the body of stomach reduces mechanical digestion and acid secretion, impairing digestion and absorption of iron, vitamin B₁₂, and other protein-bound nutrients. In addition, intrinsic factor secretion is diminished, resulting in further impairment of the absorption of the vitamin B₁₂ [9]. However, this patient showed a tendency where vitamin B₁₂ did not decrease compared to the time before surgery. Perhaps, it is due to the constant multivitamin intake for 1 year after surgery. Other references also reported unchanged or improved vitamin B₁₂ levels after surgery [8,11]. In addition, with discontinuation of medication and return to bad nutritional habits, it could take at least three to four years for vitamin B₁₂ storage to deplete [8,11]. Therefore, supplementation of multivitamin containing vitamin B₁₂ may be sufficient to maintain normal level in most patients, but follow-up over a period of 5 years or longer is likely to be required.

Bariatric surgical procedures result in impaired absorption of dietary iron by causing hypochlorhydria and bypassing major sites of iron absorption such as duodenum and proximal jejunum. There is also decreased intake of oral iron due to overall reduction in appetite and development of intolerance to food such as meat, which constitutes a major source of iron [16]. As a result, some studies have observed decreased hemoglobin levels after sleeve gastrectomy [8]. In another study of sleeve gastrectomy with long-term follow-up, low ferritin levels were observed in 36.2% of patients after 5 years compared with baseline [17]. In this patient's case, hemoglobin level was 15.9 g/dL and ferritin level was 60.6 ng/mL

before sleeve gastrectomy, but after 1 year, they were decreased to 11.8 g/dL and 28.6 ng/mL, respectively. Although the levels were decreased, they are still within the normal range. To prevent iron deficiency, menstruating women who have undergone sleeve gastrectomy, Roux-en-Y gastric bypass and biliopancreatic diversion with duodenal switch should consume 45–70 mg/day of elemental iron [3].

The prevalence of vitamin D deficiency after bariatric surgery can be as high as 100% [18]. Following bariatric surgery, an estimated 10%–25% and 25%–48% patients have shown to develop calcium deficiency by the end of 2 and 4 years respectively whereas 17%–52% and 50%–63% develop vitamin D deficiency during the same time period [19]. A Chinese study found a high prevalence of folate deficiency in patients presenting for bariatric surgery [20]. However, in a study from Canada, folate levels were almost always normal after sleeve gastrectomy, because folate deficiency is a rarely encountered disorder in Western countries due to regulations concerning fortification of grain products [11]. This patient's calcium, vitamin D and folic acid levels did not decrease at 1 year after surgery. However, long-term monitoring may still be necessary. To prevent deficiencies in vitamin D, calcium and folate several years after surgery, mineral (each containing iron, folic acid and thiamine) supplements, 1,200–1,500 mg of elemental calcium and at least 75 µg of vitamin D should be given to all patients. Folic acid should be supplemented to all women of childbearing age to reduce the risk of fetal neural tube defects [4].

In conclusion, when rapid weight loss occurs among patients who have undergone sleeve gastrectomy, a long-term follow-up is critical and the follow-up period should be short and frequent. In order to prevent malnutrition and increase calorie and protein intake appropriately after sleeve gastrectomy, dietary education should be conducted according to digestive symptoms and oral nutritional supplements should be used. In addition, to reduce complications caused by micronutrient deficiency, periodic blood tests should be conducted and education on essential intake of vitamin and mineral supplements should be delivered. However, in Korea, there are no multi vitamin and mineral supplements available that meet the recommended amounts after sleeve gastrectomy. Therefore, it is necessary to select and take supplements that meet the recommended amounts. It would be necessary to use methods such as telephone or video counseling for close intake monitoring and management through multidisciplinary counseling such as exercise prescription and psychiatric counseling would be required.

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