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Original article: Case report

A case with juvenile-onset and standard medical therapy resistant obesity associated with type 2 diabetes undergoing laparoscopic sleeve gastrectomy

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Abstract

A case of juvenile-onset morbid obesity with type 2 diabetes was studied; with a body mass index (BMI): 46.7 kg/m^2 and HbAlc: 9.8%. The patient underwent medical therapy over ten years but did not improve due to severe therapy resistant obesity. The application of a surgical treatment was considered. The patient had mental, psychological and social problems. Thus, when conducting a psychological test, determining the appropriate timing of a surgical intervention was carefully considered. The patient was treated with a preoperational weight loss program for 160 days during an educational hospitalization. At the point when BMI became 39.0 kg/m^2 and HbAlc became 6.8%, a laparoscopic sleeve gastrectomy was conducted for the patient. The postoperative process was satisfactory where BMI and HbAlc improved to 31.7 kg/m^2 and 6.0% respectively by postoperative day 80. This study reported a successful case of weight loss and improvement in diabetes which was achieved by a clinical team which performs medical practices including a bariatric surgery for a patient with juvenile-onset and standard medical therapy resistant obesity associated with type 2 diabetes.

KEY WORDS: obesity, type 2 diabetes mellitus, metabolic surgery, laparoscopic sleeve gastrectomy, bariatric surgery

Introduction

The prevalence of severe obesity among adolescents continues to increase, and individuals with complications from type 2 diabetes mellitus (T2DM) also increases in number ^{1,2}. Furthermore, cases of juvenile-onset morbid obesity and T2DM are refractory and resistant to medical therapy. These patients tend to have diversified background factors such as mental, psychological and social problems³⁻⁵⁾. However, leaving patients without treatments would trigger various obesity-related complications, which would induce a lowered quality of life and increased mortality rate⁶. Obesity treatment outcomes from recent studies have found that surgical treatments for morbid obesity provide significant effect and efficacy⁷⁻¹⁰). However, this must be applied with deliberate considerations of patients' background factors. This study reported a successful case of weight loss and improvement in diabetes experienced with a bariatric surgery for a patient who the above-mentioned factors applied to.

Study case

The patient: a female at the age of 28 years. Chief complaint: diabetes mellitus; therapeutic purpose of obesity

Anamnesis:	at the age of 10;	a surgery of slipped capital			
		femoral epiphysis (both sides)			
	at the age of 18;	onset of acute lymphocytic			
		leukemia (chemotherapy from			
		age of 18 to 20, remission after			
		then)			
	at the age of 18;	adjustment disorder			
	at the age of 19;	dysthymia			
	at the age of 22;	emotionally unstable type			
	-	personality disorder,			
		alcohol dependence, lumbago,			
		hyperlipidemia and fatty liver			
Family history: father: chronic pancreatitis, hypertonia,					
hyperlipidemia and diabetes					

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mother: neurodystonia paternal grandmother: hepatitis C two maternal uncles: diabetes maternal grandfather: diabetes (dialysis) maternal grandmother:

diabetes (leg amputation) and cerebral infarction

Life history: smoking history: 40 cigarettes per day for 14

years drinking history; wine: 3,000 mL/day, shochu

(Japanese spirit distilled from sweet potatoes, rice, etc.) 1,500 mL/day

Clinical history: The patient had been obese since she was an elementary school child. The weight was 58 kg at the age of 10, 78 kg at 11, 90 kg at 12, 108 kg at 13 and 121 kg at 15. Diabetes was diagnosed at the age of 17 by A hospital and weight loss was attempted but resulted in a failure. Acute lymphocytic leukemia was diagnosed at the age of 18. At the beginning of chemotherapy, glycemic control was unsuccessful and insulin therapy was applied. Treatments were changed from insulin to oral antidiabetic agent at the age of 20 when acute lymphocytic leukemia entered remission. Then, oral antidiabetic agent treatment continued. However, HbAlc elevated from 7% to 9% and she was hospitalized in B hospital at the age of 22. She tried to reduce her weight by only 3 kg. At the age of 24 at 112.4 kg of weight, 10.0% of HbAlc and over 2,000 mg/ dL of triglyceride (TG) (occasionally), pain in the back was mentioned, which was suspected to be pancreatitis. After transitions of varied antidiabetic agents, GLP-1 (glucagon-like peptide-1) receptor agonist, biguanide, SGLT-2 (sodium glucose co-transporter-2) inhibitory agent and thiazolidinediones were finally administered for treatment. However, morbid obesity was not improved with 127.7 kg of weight (body mass index [BMI] = 46.1 kg/m^2) and 9.4%of HbAlc. Therefore, it was judged that the internal therapy reached its limit. The patient was referred to this hospital for an adaptation of surgical treatments.

Clinical data of the first visit: morbid obesity was recognized with a height; 165.5 cm, weight; 127.9 kg, BMI; 46.7 kg/m² and blood pressure; 125/97 mmHg.

Clinical examination outcomes of the first visit: high value, 9.8% of HbAlc; leukocytosis; polycythaemia; γ -GTP increase; total cholesterol (TC) increase; TG increase.

Ethical standard

Before starting this surgery, a written consent was obtained from the patient. This study was implemented in compliance with the Helsinki Declaration (as revised in 1975, 1983). This study was approved by the ethics committee of this hospital.

Therapy policy

The patient was educationally hospitalized to determine if she was eligible for an adaptation of a bariatric surgery. Since the patient moved to this hospital, as drugs for sleeplessness and anxiolytic drugs had been prescribed as a single use (medicines to be taken as needed) by other hospitals, this hospital prescribed ramelteon (8 mg/day) and brotizolam (0.5 mg/day) for sleeplessness, and tramadol (75 mg/day) and duloxetine (20 mg/day) for external injuries and chronic lower back pain due to obesity.

The aims of the educational hospitalization were as follows: 1) weight loss and diabetes control

- 2) evaluation of the capability for the patient to endure dietary restrictions
- 3) guidance for appropriate eating manners
- 4) observation and assessment of behavioral patterns of having low caloric diet including a formula meal
- 5) assessment to judge if she would be able to withstand more severe diet control post-operation
- 6) loss of weight to reduce the quantity of visceral fat so that the lateral division of liver, which was compensatory hypertrophy due to fatty liver, could be reduced to as little as possible for the surgery to be conducted safely

Diet started with meals 1,400 kcal/day. Treatment of hypoglycemic agents had been combination chemotherapy but a single administration of SGLT-2 inhibitor tofogliflozin 20 mg/day started and was observed to assess the effect to determine if additional administrations were needed.

Endocrine examinations were conducted, and it was confirmed that the patient had primary obesity. Furthermore, a psychological test was conducted, referring to the clinical record from the introduction of the original medical institution, which showed that the patient had social and mental problems. Results of the test were as follows: Results of an intelligence test:

• The patient was skillful in dealing, on an individual level, with information required for daily life but it was difficult to store knowledge and apply knowledge to solve problems. Results of a personality test:

- The patient did not have an emotional disturbance at the time of the test.
- The patient had difficulty having objective recognitions of the actual world and tended to behave following emotion or desire rather than reason.
- With low self-esteem, she did not have active interests and rarely initiated an action.
- The patient did not have feelings of adherence to a belief or principle and it was hard for her to have her own opinion with self-assertiveness.
- With little sense of a code of conduct, it was difficult to follow rules.
- The patient was not good at controlling her behavior reasonably and positively to achieve a goal.

Her concept of self-management:

- The patient had intensive fear toward disease complications associated with obesity and was motivated to undergo selfmanagement. Thus, it was a very good timing to make an intervention.
- The patient did not have complaints about meals. However, she would be unable to refrain from drinking after leaving the hospital.
- The patient had friends to go on a diet with, but her family was not interested in her. She felt that she was not able to hope that her family would support her.

The point of an intervention:

- Understanding and incorporation of people around the patient would be necessary in her struggling with this challenge.
- It was necessary to keep away from negative attitudes and build a corporative relationship.
- To explain to and motivate the patient so that she could

tackle the challenge with self-efficacy.

- To explain concretely and specifically with sufficient and concise words.
- To begin with something that the patient thought she could do.
- To encourage the patient to take the initiative and set a goal. To praise her in an achievement and to help her to identify the factors of a failure, which could enhance her self-efficacy.
- To help the patient, asking her about feelings and ideas that she had, to put into words what she felt or thought in her mind. Employing this approach, the patient was able to face her own feelings and ideas.

For the surgical indication, a clinical team conducted meetings convened to discuss issues, including surgeons, specialists in diabetes endocrinology, psychiatrists, clinical psychologists, national registered dietitians, physical therapists, pharmacists, nurses and social workers. It was found from the psychological test results that the patient had observed severe clinical conditions of her family members and relatives, such as disease complication due to obesity and much more serious problems such as leg amputations and dialysis induced by severe diabetes. Thus, she seemed to have strong desire to have the obesity and diabetes cured. The clinical team concluded unanimously that the patient was ready for a surgery with sufficient motive to solve the problems of obesity and diabetes. It was determined that the patient had a good timing for the intervention of a bariatric surgery.

Clinical course from the educational hospitalizations to the surgery

Fig. 1 showed the changes in body weight and HbAlc at six hospitalizations. The first admission started with a diet of 1,400 kcal/day and physical exercise therapy and achieved 10 kg weight loss from 127 kg to 117 kg after about one month. Fasting blood glucose level was lowered from 228 mg/dL to 137 mg/dL, which showed that a single administration of SGLT-2 inhibitor was effective. Therefore, it was decided that the single administration was would continue without adding other agents. The patient left the hospital and stayed home for one week. Then the second admission started with a body weight of 117 kg, which was maintained without weight gain from the time of leaving the hospital. Therefore, the second admission also started with a diet of 1,400 kcal. HbAlc decreased smoothly to 8.2%. Body weight was reduced from 117 kg to 110 kg and fasting blood glucose level was improved from 213 mg/dL to 104 mg/dL during the second admission. In the third admission, the patient's diet was 1,200 kcal/day, in which formula meals were added. However, the conditions during the third admission was that body weight was reduced from 108 kg to 105 kg, fasting glucose level was reduced from 151 mg/dL to 98 mg/dL, and HbAlc was between 7.2% and 6.7%. In the fourth admission, the amount of formula meals was increased, and the total calorie count of the meals was limited to 600 kcal per day. However, body weight (from 107 kg to 108 kg) did not show a change. It was considered that a surgery was planned in the coming fifth admission on the grounds that the physical conditions of BMI: 40 kg/m² or lower and HbAlc (6.7%):



Fig. 1. Clinical course: Changes in body weight and HbA1c. LSG: Laparoscopic sleeve gastrectomy.

7% or lower indicated a safe surgery and also the effects of the diet and physical exercise therapy reached its limit. However, the planned surgery was canceled in the fifth admission, because the body weight of the patient was 116 kg, which had increased by 8 kg. The reason was a massive calorie intake of food, which was referred to as "the last supper." Then, the team of obesity and metabolism experts conducted a meeting again to determine the three conditions to perform a surgery as follows:

- 1) To confirm the intent of the patient
- To reduce the body weight during the fifth admission (the target goal was BMI: 40 kg/m² or lower)
- 3) Maximum weight gain to be permitted at the next admission was 2 kg or lower

The patient was informed that a surgery would be performed if these conditions were fulfilled, and then she consented to these conditions. Consequently, these required conditions were obtained with a body weight of 107 kg upon leaving the fifth admission and 108 kg at the sixth hospitalization. Therefore, a laparoscopic sleeve gastrectomy (LSG) was conducted during the sixth admission. The whole process of preoperational weight loss was as follows: five educational hospitalizations with periods between two and four weeks which employed diet and exercise therapy and achieved 20 kg in weight loss from 127 kg (BMI = 46 kg/m²) at the first visit to 107 kg (BMI = 39 kg/m²).

In terms of hypoglycemic agent, a SGLT-2 inhibitor was prescribed and HbAlc was improved from 9.8% to 6.8%. Visceral fat area was estimated at the first hospitalization date and immediately before the surgery, by using a visceral fat analyzer HDS-2000 (Dualscan, Omron Healthcare Co., Ltd., Muko, Kyoto, Japan)¹¹. At the first admission, the visceral fat area was 225 cm², girth of abdomen was 140 cm, which improved to 124 cm² and 125 cm respectively prior to the surgery. In *Table 1*, the data of blood examination immediate before the surgery showed a lipid abnormality. The surgery was conducted on the 160 th day from the first educational hospitalization.

Laparoscopic sleeve gastrectomy (LSG)¹²⁾: Under a general anesthesia, the procedure involved a longitudinal resection of the omentum majus starting from the antrum at the point 4 cm from the pylorus in greater curvature of stomach and finishing at the His angle. After resection of the omentum, the stomach was resected on the side of greater curvature by a surgical stapling device with the guidance

Table 1. L	aboratory data on	first visit, preo	perative day 1	, and post	operative day 80.
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		First visit	Preop 1	Postop 80
WBC	/µL	10,900	9,600	6,600
Hb	g/dL	16.5	15.7	14.8
Hct	%	50.6	47.2	45.7
Plt	x104 /µL	20.6	18.8	17.3
ТР	g/dL	6.5	6.5	6.4
Alb	g/dL	4.3	4.0	4.0
T-Bil	mg/dL	0.5	1.1	0.3
AST	IU/mL	21	16	18
ALT	IU/mL	37	17	16
ALP	IU/mL	182	197	210
LDH	IU/mL	188	183	165
γ-GTP	IU/mL	65	64	37
BUN	mg/dL	14	10	17
CRE	mg/dL	0.47	0.50	0.66
TC	mg/dL	220	265	186
HDL-C	mg/dL	74	49	66
LDL-C	mg/dL	104	160	105
TG	mg/dL	521	431	120
HbA1c [NGSP]	%	9.8	6.8	6.0
CRP	mg/dL	0.05	0.42	0.38

Preop 1, Preoperative day 1; Postop 80, postoperative day 80; WBC, while blood cell; Hb, hemoglobin; Hct, hematocrit; Plt, platelet; TP, total protein; Alb, albumin; T-Bil, total bilirubin; AST, aspartate transaminase; ALT, alanine transaminase; ALP, alkaline phosphatase; LDH, lactate dehydrogenase, γ-GTP, gamma glutamyl transpeptidase; BUN, blood urea nitrogen; CRE, creatinine; TC, total cholesterol; HDL-C, high-density lipoprotein cholesterol; LDL-C, low-density lipoprotein cholesterol; TG, triglyceride; NGSP, natinal glycohemoglobin standardization program; CRP, C-reactive protein.

of an endoscope. Thus, after surgically removing a stomach section, a small diameter gastric tube, which is a reduced stomach portion, was produced. It was inspected by the endoscope that there was no bleeding, nor contraction within the stomach, after reinforcing the staple-line.

The data from postoperative day 80 showed that the body weight was 87 kg (BMI = 31.7 kg/m^2), the weight loss from the first visit was 40 kg, and HbAlc was improved from 9.8% to 6.0%. The visceral fat area was remarkably decreased from 225 cm² to 77 cm². The data from the blood test showed the lipid abnormality was improved in *Table 1*.

Discussion

T2DM associated with juvenile-onset and morbid obesity has been an increasing social problem in Japan¹⁾. In comparison to diabetes characteristics of Europeans and Americans, Japanese diabetes tends to occur at a relatively low BMI level and juvenile-onset diabetes accounts for 20% of all the diabetes and is said to have dissatisfactory convalescence. Among patients who became T2DM by 35 years old, 60% of the patients resulted in dialysis or ablepsia by 60 years old⁶. T2DM morbid obesity patients are provided therapies of dieting, physical exercise and medication. However, no internal therapies show long-term therapeutic effects, and especially young-onset diabetes is refractory. The case in this study also showed that the patient had been treated in a specialized hospital for ten years and the weight loss treatments were not successful. The reason in this case was assumed that the patient held personality-related, mental and social problems other than nutritional and metabolic factors. Serious morbid obesity mostly involves personality characteristics which results in difficulties for treatment.

It has been proven that bariatric surgeries showed a long-term effect on weight loss in comparison with medical or internal therapies 9. It has been reported that due to development in a laparoscopic surgery, bariatric surgeries have rapidly increased in number and data on bariatric surgery outcomes have been accumulated, which recognized that mortality rate related to morbid obesity is improved due to bariatric surgeries ^{13,14}, and obesity-induced metabolic diseases are improved or cured 8, 9). In this case for the surgical therapy, mental problem must also be considered, and a surgical indication required prudent responses. Guidelines in Japan stipulate that patients with obesity are likely to have mental and psychological traits, and it is desirable that patients are interviewed by psychiatrists or clinical psychologists for assessment to obtain advice for cautionary points at pre-operation and during follow-up¹⁵). Following this guidance, the patient underwent psychological examinations, which revealed the personalities of the patients. It was found that due to the psychological tests that the patient was in the good timing for an intervention. Furthermore, a clinical team was established, consisting of surgeons, psychiatrists, internists, clinical psychologists, nurses, national registered dietitians, physical therapists and social workers, and the treatments were performed with mutual cooperation and combination work.

The patients with personal traits similar to the patient in this study case require a clinical team to support them, as their self-esteem is low, they face diversified obstructions to live a social life, and their quality of life is low physically, mentally and socially. Not only support for body weight loss, but also for the improvement of the quality of life are crucial challenges ^{16, 17)}. For patients to build up a successful experience of their own, an empowerment approach must be employed by clinical professionals ¹⁸⁾. This type of support system cannot be achieved by a single medical profession. Once diversified occupations join forces with each other, co-operation is enabled. This patient has only a short-term postoperative observation period of 80 days, so follow-up is essential in future. The team work will be necessary to reassure the patient not to rebound in the future.

The preoperative weight loss was achieved relatively smoothly due to the good timing of the intervention. The clinical team was able to overcome the weight gain in the fifth admission. Leaving the hospital after fourth admission, the weight of the patient had increased again. However, during the fifth admission, the weight was decreased by the same amount as the fourth, due to the support of the team. If the patient had been left without appropriate clinical support, she would have rebounded in body weight and would have been unable to undergo surgery. It was recognized that the surgery was performed at the correct timing, as medical therapy had reached its limit in weight loss and the patient was led to be in a safer condition for the surgery.

Patients with morbid obesity have higher risks during surgery and under anesthesia in general ^{19, 20}). Excessive offal fat and hepatomegaly due to fatty liver diseases make the working space narrow intraperitoneal so that surgical operations have difficulties, to a great extent. It was shown that preoperative weight loss by intaking low calorie meals can significantly reduce the quantity of offal fat and the volume of the liver, which is highly recommended in terms of the decrease in disease complication related to surgical operations ²¹). In fact, the visceral fat area of this patient was reduced, and the surgery was performed safety and successfully. There was no disease complication related to the surgery post-operation, and the weight loss and the improvement in diabetes were successfully achieved.

It is reported in Japan that medical care expenditure is increased for patients with T2DM with obesity²²⁾. However, myriad cases have been shown of insufficient control of blood glucose, while therapeutic agents prescribed to control blood glucose, blood pressure and lipids increase the complications of obesity, and more careful and attentive treatments are necessary. Not only in Japan, but also in the United States of America, medical costs have been increasing year by year. It has been revealed that diabetes requires the highest medical expense of all disease states ²³⁾. Obese and metabolic surgeries have drastic effects not only on weight loss but also on diabetes. It has been recognized that bariatric surgeries can reduce or put an end to medical therapy, which is greatly beneficial on the medical economy²⁴⁾. Furthermore, bariatric surgeries can reduce glycative stress and lead to the prevention of glycative-stress-related disease complications. It is hoped that surgeries for weight loss and metabolism will develop and contribute to the society as an effective method for fighting obesity and diabetes.

Conclusion

The successful clinical case of LSG was experienced for a patient with juvenile-onset and standard medical therapy resistant obesity associated with T2DM. The clinical team supported the patient with mental and psychological problems to have educational hospitalizations with successful preoperative weight loss. LSG was performed for the patient and weight loss and diabetes were improved.

Conflict of interest

There are no items related to conflict of interest for this study to conduct.

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