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Preparation of a severely obese adolescent for significant and long-term weight loss: An illustrative case

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Abstract

For severely obese patients planning bariatric surgery, many surgeons advise preoperative weight loss which can be difficult for some to achieve. We report a 16 year old male who was referred for weight loss surgery in a very late stage of severe obesity with a weight and BMI of 310 kg and 93 kg/m², respectively. He also suffered from obstructive sleep apnea and hypertension. To prepare him for laparoscopic gastric bypass, a strict preoperative nutritional intervention with inpatient and outpatient phases was designed. He lost 22 kg preoperatively and an additional 86 kg by 67 months postoperatively, representing a 35% total reduction in BMI. This case illustrates the feasibility and value of a defined preoperative dietary intervention to effectively manage the weight of an adolescent referred late in the progression of severe obesity.

Keywords

bariatric surgery; gastric bypass; diet

Introduction

Initiating weight loss prior to bariatric surgery in severely obese patients has been associated with improved operative safety and other health benefits [1]. In particular, a reduction in operative time [2], intraoperative blood loss [3], and other complications [4, 5] have been linked to preoperative weight loss. Preoperative weight loss can also significantly decrease the liver size, may reduce length of hospital stay, and may lead to more rapid weight loss following operation [6].

Very little attention has been given to optimal preoperative weight loss strategies for severely obese adolescents. In particular, little objective data is available about appropriate use of inpatient resources in extreme cases. This report highlights medical decision-making in the preparation of an adolescent with a remarkable BMI of 93 kg/m² for weight loss surgery, and illustrates 5 year results that can be obtained with surgical management.

CASE REPORT

A 16 year old black male with a history of obesity dating back to early childhood was referred for consideration of surgical weight loss. As early as age 4, at a weight of 57 kg, he was >99th percentile of weight for age. His evaluation by a dietician revealed multiple risk factors for abnormal weight gain including multiple caretakers and minimal involvement from his parents in his diet and exercise. His intake and activity were characterized by

excessive food portions, constant snacking, very high levels of caloric intake (estimated at over 4,000 kcal/d), and only moderate physical activity. This resulted in an early onset of accelerated linear growth (at age 6, his bone age was 10 years), acanthosis nigricans, and elevated blood pressure for age (120/80 mmHg). Over 3 months, he was able to lose only one kg on a low calorie diet and an exercise regimen.

By age six, his BMI was 45 kg/m². He began a more structured weight management program, and in the first 13 months he lost 6 kg, while increasing 6 cm in height. However, in the last 2 months of this intervention, he regained 8 kg.

At age 16, with a weight of 294 kg and a BMI of 88 kg/m² (328% over ideal weight), he had developed obstructive sleep apnea (apnea-hypopnea index 10 events/hour) requiring treatment with continuous positive airway pressure at night, arterial hypertension managed with metoprolol, lisinopril, and hydrochlorothiazide, dyslipidemia treated with niacin, and insulin resistance with normal fasting glucose. He also suffered with weight related arthralgias, particularly the left knee, requiring naproxen and dextropropoxyphene.

Although the patient clearly met medical criteria for weight loss surgery in adolescence with an extreme BMI and multiple significant comorbidities, the decision to proceed with surgery was complicated by several factors, warranting a cautious approach. He had gained 16 kg in the 6 months prior to his initial surgical consultation visit, indicating ongoing risk factors driving very rapid weight gain. It was unclear if he--in his social and family environment--could be adequately prepared for a complex weight loss intervention, especially one which requires active patient and family participation to succeed.

During 6 months of outpatient preoperative preparation, his weight initially decreased from 310 kg to a low of 304 kg, but then increased to 311 kg, exceeding the weight at the time of the initial assessment [Figure]. The patient was frustrated by his lack of sustained weight loss. Given the failure of conventional outpatient nutrition and physical activity recommendations to impact his weight, and his seemingly earnest desire to put adaptive behaviors into place, a more aggressive inpatient weight loss plan was proposed. The goals were to reduce dietary intake and promote a more structured lifestyle and physical activity program in a controlled environment.

The inpatient meal prescription consisted of one liquid supplement (Boost- 240 kcal, 15 g protein, Nestlé HealthCare Nutrition, Fremont, MI) at breakfast, two at lunch, two at dinner, and one for an evening snack. Multiple flavors provided a variety of choices for his meals. He was also encouraged to drink as much non-nutritive fluids as he desired. This high protein liquid regimen provided 1440 kcal/day and 90 grams/day of protein. Fiber (Benefiber, Novartis Consumer Health, Inc., Parsippany, NJ) was added to his liquid meal, starting at 1 gram of fiber per meal and gradually increasing until he received 25 gram of fiber per day. Meal times were fixed, although non-nutritive liquids were available ad-libitum. Each day, his routine consisted of three 30 minute exercise sessions, dedicated time for schoolwork, and appropriate free time.

During his 13 day inpatient regimen, he demonstrated good compliance. Twelve days into the exclusively liquid diet plan, one can of the protein supplement was eliminated and a high protein meal was added in an attempt to enhance the sustainability of the intervention after discharge by adding solid food and variety. At discharge on day 13, the prescribed daily intake was 4 cans of high protein Boost (960 kcal) and one lean protein meal providing 225–240 kcal per serving. He was instructed to continue this diet and the daily physical activity regimen as an outpatient. His discharge weight was 298 kg, a loss of 13 kg in 13 days [Figure and Table].

Over the ensuing 6 weeks after discharge, an additional 10 kg was lost. The preoperative weight loss was associated with improvement in hyperinsulinemia, and reductions in both LDL cholesterol and serum ferritin. He underwent an uncomplicated laparoscopic RYGB, using a retrocolic, antegastric reconstruction with roux limb length of 150 cm and a hand sewn, 2 layer gastrojejunal anastomosis. He had an uneventful 4 day hospital stay postoperatively. Starting two weeks postoperatively, he began to walk 5 days per week for 30 minutes, and began resistance training 3 days per week. Three months following the operation, his weight had decreased an additional 50 kg.

At 12, 40, and 67 months after surgery, his BMI was 55 kg/m², 49 kg/m², and 61 kg/m² respectively [Figure and Table]. Thus, following bariatric surgery, he lost 86 kg, a 30% reduction postoperatively. When considering combined weight loss during preoperative and postoperative phases, his total weight loss was 35%. His laboratory assessments also demonstrated significant improvements with declines in ALT, LDL cholesterol, triglyceride, insulin and glucose levels and increase in HDL cholesterol [Table]. He did not experience anemia or hypoalbuminemia, but did have persistently low 25-OH vitamin D levels at most recent measurement. He still suffered with arthralgias on a weekly basis and low back pain monthly, but did not require analgesic medication. He was still hypertensive but reported a remarkably improved quality of life, with ability to attend college, and to play basketball and football with friends.

DISCUSSION

The findings in this case report are unique as there are no similarly detailed reports of preoperative preparation and long term outcome of a severely obese adolescent available. Pre-operative very low calorie liquid meal replacement programs have been used in adults before surgery to achieve clinically meaningful weight loss. Although an inpatient stay can be resource intensive and costly, it may be justifiable to initiate a strict treatment plan when outpatient treatment has been unsuccessful. An 11 week very low calorie liquid inpatient regimen (<900 kcal/day) for adult bariatric patients resulted in an average loss of 38.9 kg [85.8 lbs], but this occurred entirely during the supervised inpatient stay [7]. In this adolescent patient's 13 day inpatient stay with a 1440 kcal/day regimen, he lost 13 kg and went on to lose an additional 10 kg in 6 weeks after being discharged, resulting in a total of 23 kg [50.7 lbs] total loss in 8 weeks. Our case suggests that the diet and exercise behaviors necessary for successful preoperative, as well as postoperative, weight loss can be taught in a significantly shorter time period, avoiding a more expensive extended inpatient stay. In a controlled setting that eliminates social and environmental factors promoting weight gain, greater comprehension and execution of an intensive nutritional and physical activity prescription can be achieved. In this case, the regimen was designed to reinforce behaviors and eating patterns that would also be useful postoperatively. The high-protein liquid diet, a sugar-free fluid goal, and a structured meal time pattern was well tolerated and resulted in significant weight loss prior to surgery, with maintenance of these behaviors and weight loss post-discharge.

Maintaining dietary interventions for weight loss can be a challenge for biological reasons that are increasingly becoming clear [8]. Not only does this case demonstrate that a structured setting can be useful for initiating preoperative weight loss, but it also illustrates the *sustained and significant* weight loss that can be achieved following effective bariatric procedures, even in cases of severe adolescent obesity. RYGB is believed to trigger powerful neuroendocrine mechanisms resulting in dramatic changes in appetite [9] and energy intake [10]. If these anatomic and physiologic responses to surgery are maintained long term, durable weight loss should be seen. When compared to other adolescents who have undergone RYGB contemporaneously in this program, the subject of this case report

demonstrates similar percent weight loss results. The mean BMI of other patients in our program has been reported at 60.2 kg/m², and the mean postoperative BMI change –37% [11], very similar to this patient's loss of 40% 40 months postoperatively and 35% at 67 months postoperatively. While this degree and durability of weight loss certainly represents success on the one hand, it is also true that certain comorbidities may not be remedied when surgical therapy is applied so late in the process of severe obesity. In this case, while some aspects of his health improved, his hypertension and arthralgias did not resolve, possibly because his postoperative BMI value still indicated severe obesity. Thus, “waiting” until an adolescent has an extremely high BMI (e.g., >60 kg/m²) to first consider surgery may well preclude the satisfactory reversal of severe obesity and some related comorbid conditions [11].

Though maintaining an overall weight loss of 35% post-operatively, our patient gained 13.6 kg [30 lbs] between his 40 month and 67 month visits. He had limited phone contact with the program in the time period between these 2 visits, as he had missed his 4 year annual visit. This weight regain, as well as the persistently low vitamin D 25-OH levels, highlight the importance of continuing annual follow-up to encourage and reinforce healthy behaviors to maintain weight loss and to track nutritional status. This patient had persistently low vitamin D levels at all post-operative time points, despite prescribed vitamin D supplementation since surgery. His pre-operative vitamin D status was unknown. Bypass procedures have been associated with vitamin D deficiency. In addition, obese as well as black and dark-skinned individuals have a higher prevalence of vitamin D deficiency at baseline as well [12]. Vitamin D status is clearly important for bone health, but is also increasingly felt to be important in regulating the immune system [13]. This patient's PTH levels doubled and became abnormal between 19 and 67 month follow ups indicating development of secondary hyperparathyroidism. Supplementation with vitamin D and achieving normal levels will be important to avoid onset of osteomalacia. Vitamin D with calcium had been prescribed since surgery and was increased to 2000 IU daily at his 40 month follow-up.

In conclusion, this case illustrates that a severely obese adolescent who was unable to manage his rapid weight gain using conventional outpatient counseling was successful with a short term two week intensive inpatient liquid diet and physical activity plan, and was able to continue with weight loss after discharge prior to surgery. Moreover, this individual has also demonstrated durable surgical weight loss postoperatively for the first 67 months and in as much as one case can be instructive, would suggest that even in the worst cases of advanced severe obesity, surgery can result in a clinically significant response.

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Figure 1.
Figure BMI changes and associated events

Table

Pre- and post-operative measurements

	Preoperative month					Postoperative month					
	-9	-2.5	-2	-1.5	-0.2	0	5	12	19	40	67
Weight (kg)	310	319	311	298		288	226	189	164	172	202
BMI (kg/m ²)	93	96	93	89		86	68	55	48	49	61
ALT (U/L)			32		38		27	22	24	21	22
Chol (mg/dL)			128		107		109	95	114	124	130
HDL (mg/dL)			44		32		36	35	55	60	55
LDL (mg/dL)			79		69		65	48	53	54	64
TG (mg/dL)			46		26		38	<30	30	<30	57
HbA1c (%)							4.1	4.8			4.8
Insulin (uU/mL)			36		26		10	5	11	9	3.8
Glucose (mg/dL)					94		70	72	76	80	78
BUN (mg/dL)			6		8		9	8	9	11	11
Cr (mg/dL)			0.9		0.7		0.7	0.7	0.7	0.7	0.7
Ferritin (ng/mL)			81		39		40	25	22		30
Iron (ug/dL)			49		62		78	46	101		132
Hb (g/dL)			12.4		12		14	13	13.7		13
MCV (fL)			83		90		91	90	90		90.2
Alb (g/dL)			4.9		3.8		3.9	3.9	4.8	4.2	4.1
Folate (ng/mL)			512				373	351	293		321
PTH (ug/mL)								51	59		110
Vit B1 (ug/dL)					3.9		3.6	97	34		
B12 (pg/dL)							447	269	381		222
Vit D (ng/mL)								5.8	11.4	8.6	5.2