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Surgery for Obesity and Related Diseases 11 (2015) 602–606

SURGERY FOR OBESITY AND RELATED DISEASES

Original article

Changes in liver volume and body composition during 4 weeks of low calorie diet before laparoscopic gastric bypass

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Received May 30, 2014; accepted July 17, 2014

Abstract

Background: Weight loss before laparoscopic Roux-en-Y gastric bypass (LRYGB) is desirable, because it can reduce liver volume and thereby facilitate the procedure. The optimal duration of a low-calorie diet (LCD) has not been established. The objective of this study was to assess changes in liver volume and body composition during 4 weeks of LCD.

Methods: Ten women (aged 43 ± 8.9 years, 114 ± 12.1 kg, and body mass index 42 ± 2.6 kg/m^2) were examined on days 0, 3, 7, 14, and 28 after commencing the LCD. At each evaluation, body composition was assessed through bioelectric impedance analysis, and liver volume and intrahepatic fat content were assessed by magnetic resonance imaging. Serum and urine samples were obtained. Questionnaires regarding quality of life and LCD-related symptoms were administered.

Results: In total, mean weight decreased by 7.4 ± 1.2 kg (range 5.7–9.1 kg), and 71% of the weight loss consisted of fat mass according to bioelectric impedance analysis. From day 0 to day 3, the weight loss (2.0 kg) consisted mainly of water. Liver volume decreased by 18% ± 6.2%, from 2.1 to 1.7 liters ($P < .01$), during the first 2 weeks with no further change thereafter. A continuous 51% ± 16% decrease was seen in intrahepatic fat content. Systolic blood pressure, insulin, and lipids improved, while liver enzymes, glucose levels, and quality of life were unaffected.

Conclusion: A significant decrease in liver volume (18%) occurred during the first 2 weeks of LCD treatment, and intrahepatic fat gradually decreased throughout the study period. A preoperative 2-week LCD treatment seems sufficient in similar patients. (Surg Obes Relat Dis 2015;11:602–606.)

Keywords: Laparoscopic gastric bypass; Low-calorie diet; Magnetic Resonance Imaging; Morbid obesity; Bioelectric impedance analysis; Intrahepatic fat

Nonalcoholic fatty liver disease is common among morbidly obese [1]. An enlarged liver obscures the gastro-esophageal junction and makes completion of the gastric pouch and suturing of the gastrojejunostomy difficult in laparoscopic Roux-en-Y gastric bypass (LRYGB) surgery, the most common bariatric procedure worldwide [2]. Preoperative weight loss, often achieved through low calorie diet (LCD) or very low calorie diet [3–7], has been associated with shorter operating times and a reduced number of complications [4,8]. From a previous study using magnetic resonance spectroscopy on morbidly obese

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http://dx.doi.org/10.1016/j.soard.2014.07.018

women, the authors reported that 4 weeks of a LCD resulted in a 12% reduction in liver volume and a 40% decrease in intrahepatic fat [5]. These changes facilitated LRYGB [5]. The optimal length of LCD treatment is not known, and some patients find LCD cumbersome and marked catabolism at surgery could be a disadvantage. Many patients notice a large initial effect on weight, and a reduction in glycogen, partially stored in the liver, coupled with water could be responsible for the initial weight loss and decrease in liver volume [9].

The aim of this study was to assess alterations in body composition, liver volume, and intrahepatic fat in morbidly obese women during 4 weeks of preoperative LCD, with focus on early changes. A secondary aim was to evaluate patient-related outcome measures regarding hunger, well-being, and quality of life during the LCD regimen.

Materials and methods

This was a prospective observational study during 4 weeks of LCD treatment. Patients were recruited among morbidly obese women awaiting LRYGB. Patients with metal implants or weight above 140 kg were excluded due to magnetic resonance limitations. Of 12 invited patients, 2 patients declined because of lack of time; thus, 10 patients completed the study. The study was approved by the regional ethical review board, and written informed consent was acquired from all participants. The study was registered at Clinicaltrials.gov, #NCT01842425.

Weight loss was achieved through LCD (Modifast, Impolin AB, Stockholm, Sweden) and 4–5 sachets were provided daily, amounting to a total energy content of 800–1100 kcal/day (carbohydrates 52%, protein 25%, fat 21%). Patients were evaluated identically on the mornings of day 0, 3, 7, 14, and 28. To facilitate comparisons between measurements, fluid consumption was restricted to a total of 500 mL of water during 12 hours before each examination. Patients´ height, weight, and resting blood pressure were measured. Blood samples were analyzed for hemoglobin, blood lipids, glucose, insulin, alanine aminotransferase (ALT), and aspartate aminotransferase (AST). Morning urine was tested for ketonuria.

Body composition was assessed through bioelectric impedance analysis (BIA) (BC-418 Segmental body composition analyzer, Tanita Corporation, Tokyo, Japan) after placing 4 leads on hands and feet. From the impedance, 3 body compartments were calculated: total body water, fat mass, and fat free mass.

Liver volume and intrahepatic fat were determined with magnetic resonance imaging (MRI) at 1.5 T (Achieva, Philips Healthcare, Best, The Netherlands) using the body coil. Liver volume imaging was performed using a single breath hold, spectrally fat suppressed, three-dimensional gradient echo sequence. Liver volume was assessed by one blinded operator using a semi-automated segmentation software [10] and randomization of the visit order to reduce effects of eventual drift in the segmentations. The measurement protocol was repeated after 3 weeks with an intra-operator coefficient of variation of 2.5% ± 1.8%. Average liver volumes were used. Intrahepatic fat content was assessed using a single breath hold, spoiled, three-dimensional 6-gradient echo sequence. Water-fat separation and intrahepatic fat measurements were performed as previously described [11].

At each evaluation, patients completed a questionnaire rating symptoms associated with LCD on a visional analogue scale (supplementary online Appendix A). A health-related quality-of-life questionnaire from Euro Qol (EQ-5 D) was also administered, allowing the patient to classify her health on 5 specific dimensions: mobility, self-care, usual activities, anxiety/depression, and pain/discomfort, as well as general health assessment. All 10 patients completed 4 weeks of LCD according to protocol and underwent LRYGB without complications.

Statistical analysis

Student's t test was used to assess changes in BIA and MRI. Wilcoxon matched pairs was used to assess changes in laboratory data. Fisher exact test was used to compare proportions. Correlations are reported as Pearson's correlation coefficients. A P value $<.05$ was considered significant. Statistical analysis was performed using Statistica (Statsoft, Tulsa, OK). Unless otherwise stated, values are presented as mean with standard deviation.

Results

During 4 weeks of LCD, mean weight decreased by 7.4 ± 1.2 kg (range 5.7–9.1 kg) corresponding to a body mass index reduction of 2.6 kg/m^2 (Table 1). Weight loss was consistent in all patients throughout the study, except in one patient who gained .1 kg between 2 visits. Weight loss was most pronounced between day 0 and day 3, with a mean weight loss of .7 ± .3 kg/d. At day 3, 51% of the weight loss was accounted for by loss of water according to BIA. A continuous reduction in body fat mass by 5.3 ± 2.0 kg, representing 9% of total body fat mass, was noted throughout the study. Details are shown in Table 1.

A large variation in liver volume, ranging from 1.6 l to 4.0 l liters, was observed at baseline. Mean liver volume decreased by 18% ± 4% from day 0 to day 14 and remained unchanged during the following 2 weeks (Figs. 1 and 2). This was consistently seen among all patients. The individual decrease in liver volume during the study ranged from 7%–30%, with no detectable correlation seen to the degree of weight loss. Liver volume at baseline was correlated to intrahepatic fat percentage ($P = .02$, r = .73). Mean intrahepatic fat percentage decreased from