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Original article

Timing of food intake is associated with weight loss evolution in severe obese patients after bariatric surgery

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SUMMARY

Background: Recent research has demonstrated a relationship between the timing of food intake and weight loss in humans. However, whether the meal timing can be associated with weight loss in patients treated with bariatric surgery is unknown.
Objective: To evaluate the role of food-timing in the evolution of weight loss in a sample of 270 patients that underwent bariatric surgery with a follow-up of 6 years.
Methods: Participants (79% women; age [mean ± SD]: 52 ± 11 years; BMI: 46.5 ± 6.0 kg/m^2) were classified according their weight loss response patterns after bariatric surgery: good weight-loss-responders (67.8%), primarily poor weight-loss-responders (10.8%) or secondarily poor weight-loss-responders (21.4%). Then, they were grouped in early-eaters and late-eaters, according to the timing of the main meal (before or after 15:00 h). Obesity and biochemical parameters, energy and macronutrients intake, energy expenditure, sleep duration, and chronotype were studied.
Results: The percentage of late eaters (after 15:00 h) was significantly higher in the primarily poor weight-loss-responders (~70%) than in both secondarily poor weight-loss-responders (~42%) and good weight-loss-responders (~37%) ($p = 0.011$). Consistently, primarily poor weight-loss-responders had lunch later as compared to good and secondarily poor weight-loss-responders ($p = 0.034$). Age, gender and type of surgery were not determining. Surprisingly, obesity-related variables, biochemical parameters, pre-surgical total energy expenditure, sleep duration, chronotype, calorie intake and macronutrients distribution, were similar among groups.
Conclusions: Weight loss effectiveness after bariatric surgery is related to the timing of the main meal. Our preliminary results suggest that the timing of food intake is important for weight regulation and that eating at the right time may be a relevant factor to consider in weight loss therapy even after bariatric surgery.

1. Introduction

Treatment for severe obesity includes life style changes, such as dietary interventions and exercise, and bariatric surgery [1]. From those approaches, bariatric surgery is the most successful weight loss strategy for severe obesity and its health benefits are beyond weight loss [2]. In terms of weight outcomes in bariatric surgery, “success” is described as loss of >50% excess weight (% EWL), loss of

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>20–30% of initial weight, and achieving a BMI <35 kg/m^2, with the maximum weight loss being observed typically during the post-operatively period between 18 and 24 months [3]. Nonetheless, weight loss after bariatric surgery varies widely and a significant proportion of patients respond poorly [4–6]. Description of patterns of weight change within this variability has seldom been attempted [5]. Recently, de Hollanda et al. [5] have reported the high inter-individual variability of the weight loss response following surgery in a Mediterranean population. Interestingly, poor weight loss after bariatric surgery could be illustrated by two different patterns: primarily poor weight-loss-response (approximately 5% of the patients) characterized by sustained limited weight loss, and secondarily poor weight-loss-response (approximately 20% of the subjects) characterized by a successful initial weight loss but subsequent weight regain leading to a final EWL <50%.

A substantial amount of research has addressed the association of poor weight loss response after bariatric surgery with a complete set of factors, potentially involved in the variation of postsurgical responses, such as: clinical [6], genetic [7], hormonal [8], and nutritional [9]. However, the role and relative importance of all these factors in the variability of weight loss outcomes after bariatric surgery is not well understood. Current studies suggest that not only “what” we eat, but also “when” we eat may have a significant role in obesity treatment [10–14]. Moreover, recent research links energy metabolism to the circadian clock at different levels: behavioral, physiological and molecular, concluding that the timing of food intake itself have a major role in obesity [10,13]. Our group, in a longitudinal study with an overweight and obese Mediterranean population, recently found that those who ate their main meal later in the day (lunch for this population) lost significantly less weight than those who ate lunch early, although early eaters and late eaters showed similar intake and physical activity, dietary consumption, macronutrient distribution, sleep duration and hormone levels [13]. These results suggest that eating late may weaken the achievement of weight loss therapies [12,13]. Furthermore, we have demonstrated in a randomized, crossover trial that eating late lunch is associated with a decreased of a) resting-energy expenditure, b) fasting carbohydrate oxidation and c) glucose tolerance [12]. Moreover, eating late lunch flattened daily profile in levels of free cortisol and decreased thermal effect of food on wrist temperature [12]. Also, a recent human study has shown that the time of food intake affects both the energy expenditure and the metabolic responses to meals [14]. Nevertheless, there is currently no evidence that food timing can predict weight loss in severe obese patients submitted to bariatric surgery. Therefore, the aim of our observational prospective study (6 years of follow up) was to evaluate if food timing is associated with the weight loss effectiveness following bariatric surgery in a cohort of severe obese.

2. Subjects and methods

2.1. Participants and procedures

Participants in our observational prospective study were selected from the 1135 subjects that underwent bariatric surgery at the Hospital Clinic of Barcelona (Spain) between 2006 and 2011. Inclusion criteria included age ≥18 years, first-time bariatric surgery, and 60 months of available follow up. From those who fulfilled the eligibility criteria, a total of 320 patients agreed to participate. Fifteen % of the initial volunteer subjects dropped out of the trial. Finally, a total of 270 patients (79% women) participated in this study. Patients were considered for bariatric surgery based on the current guidelines, which include to have a body mass index (BMI) ≥40 kg/m^2 or to have a BMI ≥35 kg/m^2 with 2 or more health risk factors, such as high blood pressure or diabetes [15]. Two commonly performed surgery techniques were performed, namely Roux-en-Y gastric bypass (RYGB; n = 203) and sleeve gastrectomy (SG; n = 67). The technical aspects of those surgery techniques and the criteria for selection of RYGB or SG at the Hospital Clinic Barcelona have previously been reported [16]. Data were prospectively collected prior to the surgery and at 12, 18, 24, 36, 48, 60 and 72 months (6 years) in the postsurgical period. All procedures were in accordance with good clinical practice. Patient data were codified to guarantee anonymity.

All subjects attended both group and individual sessions, which included nutritional counseling according to the current guidelines for the bariatric patient prior the surgery [15]. Dietary advice was given to the patients after surgery: at 2 and 6 weeks, and then at 4, 8, and 12 months, emphasizing to sustain a hypocaloric and proteinrich diet, rather than a recommendation of specific timetable. During the first year after the surgery, the patients were advised to eat 5–6 meals per day and after this first year, to eat 3–4 meals per day. No different nutritional education was given according to the type of surgery.

2.2. Ethics

The study followed the ethical guidelines of the Declaration of Helsinki 1961 (revised Edinburgh 2000) and the current legislation concerning clinical research in humans. Ethics Committee of the Hospital Clinic Barcelona approved the protocol and the written informed consent was obtained from all the participants of the study.

2.3. Obesity and biochemical parameters

Participants were weighed wearing light clothes and without shoes to the nearest 0.1 kg (Seca 703 scale, Hamburg, Germany). Height was determined using a fixed wall stadiometer (Seca 217, Hamburg, Germany) to the nearest 0.1 cm. Waist circumference was measured to the nearest 0.5 cm, at the level of the iliac crest, and hip circumference was measured to the nearest 0.1 cm to the maximum extension at the buttocks level. All measurements were made with a standard flexible and inelastic measuring tape. Body mass index (BMI) was calculated as weight (kg) divided by squared height (meters). Postoperative weight loss (WL) was expressed as a percentage excess of weight loss (%EWL) following the formula: EWL = [100 × (weight prior to surgery − weight at the time of evaluation)/(weight prior to surgery − weight corresponding to body mass index (BMI) = 25 kg/m^2)]. Plasma cholesterol, triglycerides, lipoproteins' concentrations were determined by automated chemical analysis at the Hospital Clinic of Barcelona.

2.4. Energy and dietary intake before and after bariatric surgery

The dietary intake was analyzed through 4-days food records (one of which was a non-working day) that were collected at every follow up prior and after surgery. For the purpose of our study we have included: a) prior to surgery (initial values), b) at nadir weight, and c) at the last follow up. Instructions about how to fill the 4-days record were explained by a registered dietitian during the clinical evaluations. Patients were instructed to complete the dietary records the week prior to the nutritional interview. Total energy intake and macronutrient composition were analyzed using the software Dietsource 2.0® (Novartis). During the follow-up period of each subject, patients also registered the time (hour) when each meal began (for example, breakfast, lunch and dinner) with the questionnaire developed by Bertéus-Forslund et al. [17] The cohort

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