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Brief report

Effect of Roux-en-Y gastric bypass and sleeve gastrectomy on taste acuity and sweetness acceptability in postsurgical subjects

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ABSTRACT

Objective: Data on taste acuity after bariatric surgery are scarce, and taste perception after sleeve gastrectomy, to our knowledge, has never been investigated. The objective of this work was to retrospectively compare taste acuity and sweetness acceptability after Roux-en-Y gastric bypass and sleeve gastrectomy.
Methods: Subjects with a postoperative period ≥6 mo were recruited (between January and June 2012) for a non-randomized, observational study. Subjects completed sensory evaluation sessions consisting of measurement of detection thresholds for bitterness and sweetness ($N = 21$), saltiness and sourness ($N = 19$), and sweetness acceptability ($N = 19$). Significance was established with Tukey's honest significant difference test and analysis of variance using the SAS GLM procedure.
Results: Sourness threshold was significantly higher among subjects who had undergone Roux-en-Y gastric bypass ($P = 0.0045$). No other differences were obtained for the other thresholds or sweetness acceptability ($P > 0.05$).
Conclusions: Further randomized studies are needed to clarify these differences.

Introduction

The prevalence of adult obesity (body mass index [BMI] ≥30 kg/m^2) has reached worrisome levels in the Middle East, particularly in Lebanon, where it significantly increased from 17.4% to 28.2% within a period of 12 y (1997–2009) [1].

Bariatric surgery appears to be an effective and lasting procedure for extreme obesity when other measures do not yield the target weight loss. Although Roux-en-Y gastric bypass (RYGB) is the most commonly performed bariatric surgery worldwide, global trends have indicated a considerable increase in the number of sleeve gastrectomies (SGs) performed from 2003 to 2011 [2].

The effects of obesity surgery on taste detection have been assessed by investigators in an attempt to physiologically explain the changes in food preference, and are controversial across the literature. Previous taste acuity studies with RYGB have yielded mixed results, with significant differences between pre- and postsurgery for bitter and sour tastes only [3], a significant decline only in sweet recognition threshold [4], and a higher sensitivity for sweet taste [5].

To date, no study has assessed taste acuity differences between prospective RYGB and SG subjects. An understanding of the changes in taste acuity and sweetness acceptability, and food preferences in general, is essential for maintaining long-term weight loss postsurgery and for developing improved follow-up strategies. The objective of this pilot study was to compare the effects of RYGB and SG on taste acuity and sweetness acceptability in postsurgical subjects.

Material and methods

Study design and subject recruitment/selection

A total of 21 subjects who had undergone either RYGB or SG were recruited throughout a 6-mo period (January–June 2012) in a retrospective fashion from the bariatric surgery database available at the American University of Beirut (AUB) Medical Center, a private hospital, to participate in this study. Subjects fulfilled the inclusion and exclusion criteria, which were as follows: 1) postoperative period ≥6 mo; 2) no pregnancy, 3) no substance abuse (alcohol or drugs); 4) no severe medical/psychological illness that would prevented participation, 5) no history of major operations on the gastrointestinal tract, and 6) no major postoperative complications after bariatric surgery. Evaluation of taste acuity and sweetness acceptability took place at the AUB sensory

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laboratory. The institutional review board at AUB approved the study protocol, and all participants were provided with and submitted an individually written informed consent.

Data collection

Demographic and anthropometric measurements

Demographic data and characteristics of the subjects (sex, age, height, weight before and after surgery, preoperative comorbidities, and date of bariatric surgery) were obtained from the patients' medical records. These were independent of the taste tests in terms of timeline and were recorded 1 y postoperatively because most of the weight loss would have occurred by then and the weight tends to stabilize afterward.

Sensory evaluation of taste acuity

Two types of sensory tests were conducted: the 3-Alternative Forced Choice (3-AFC) test to measure recognition thresholds for the four basic tastes (salt, sour, sweet, and bitter), and a sweetness acceptability test to measure acceptability for different sucrose solutions.

The 3-AFC test was administered using the ascending method of limits [6], whereby nine stimulus levels for each taste were selected based on preliminary tests and previous studies and standards found in the literature [7,8]. The 3-AFC at each level had one sample as the stimulus and two other blank solutions [7, 8]. Participants were asked to identify the sample that was more intense on a specific taste. Stimulus solutions for sweetness, sourness, saltiness, and bitterness consisted of dissolving 10.95 g sucrose, 0.54 g citric acid 1-hydrate, 3.65 g sodium chloride, and 0.078 g quinine sulfate in 500 mL water, respectively, resulting in corresponding initial concentrations of 64 mmol/L, 8 mmol/L, 112 mmol/L, and 200 μmol/L, respectively, for the tastes (highest levels, level 9). Subsequently, eight less concentrated stimulus levels for each taste were prepared using a dilution factor of 2 of the previous level. One ascending series was used for each basic taste, starting with the lowest level and following a geometric progression of a factor of 2 up to the highest (ninth level) indicated in the aforementioned concentrations. Twenty-one subjects (12 from the SG group and 9 from the RYGB group; 70% response rate) completed the bitterness and sweetness threshold tests and 19 of the 21 (11 from the SG group and 8 from the RYGB group) completed the saltiness and sourness threshold tests, with 2 subjects dropping out and not completing the latter threshold tests. In the sweetness acceptability test, subjects ($N = 19$, 11 from the SG group and 8 from the RYGB group) were provided with ascending concentrations of sucrose (2%, 4%, 6%, 8%, 10%, 12%, 20%, 30%, and 40%) and asked to rate their acceptability on the 9-point hedonic scale [8]. Sugar-free Kool Aid sachets were used for the acceptability test, and the sugar concentrations were adjusted using a hand-held Brix refractometer (RHB 0-80).

The threshold and acceptability tests were conducted in two sessions: Each session included a 3-AFC test for two basic tastes, and one of either session covered the acceptability test for sucrose solutions. All samples were prepared in batches 1 d before the evaluation sessions and stored at 4°C until serving. Samples were served, at room temperature, in 50-mL plastic cups coded with three-digit random numbers. The serving sequence of samples was counterbalanced among the panelists for each level, as was the sequence of the different basic tastes set [9]. Subjects were seated in individual booths with white fluorescent lighting and were provided with a tray containing the samples, a cup of water for palate rinsing between ascending levels (subjects were expectorating the water to avoid digestive discomfort that could be caused by the small volume of the stomach postsurgery, which could be filled up quickly with any amount of fluid), napkins, and the sensory questionnaire to write their answers. Subjects were allowed to rest for 5 to 10 min, depending on preference, between tests. Subjects attended the evaluation sessions at different times of the day (mostly between 09:00 h and 16:00 h), depending on their availability. They were instructed not to eat or drink anything (except water if need be) 2 h before the start of either session so that their taste palatability would not be affected. Both evaluation sessions averaged 30 to 40 min in total.

Data and statistical analysis

The main variables were three continuous variables—age (y), weight (kg), and postoperative period (mo)—and three discrete variables—sex (male-female), surgery type (RYGB-SG), and preoperative comorbidities classified into three groups (none, one comorbidity, and two or more comorbidities). The postoperative period was time elapsed from surgery date to the date of the initial interview with the dietitian. All statistical analyses were performed in SAS statistical software (Version 9.02, SAS Institute, Cary, NC). Significant means were separated by Tukey's honest significant difference test. Analysis of variance was performed using the GLM procedure. Recognition thresholds for taste acuity were calculated as the geometric mean of concentrations between an incorrect response and a correct response that is followed only by correct responses.

Results

Participants ranged between 20 and 62 y in age. Despite the seemingly large difference in age between the subjects of the two groups (RYGB and SG), there was no significant age difference, and the two groups did not differ on any of the variables (Table 1).

There were no significant differences between RYGB and SG subjects for the taste thresholds of sweetness, saltiness, and bitterness. However, RYGB and SG subjects significantly differed in sourness thresholds. The threshold was higher, and hence the sensitivity lower, among RYGB subjects than among SG subjects (2.51 ± 2.5 versus 1.16 ± 0.9, $P = 0.0045$) (Fig. 1). There was no significant difference in sweetness acceptability despite a slightly higher mean rating, across all sucrose concentrations, among SG subjects compared with RYGB subjects (4.9 ± 2.8 versus 4.8 ± 2.3, $P > 0.05$) (Fig. 2). Sweetness level, i.e., the different sucrose concentrations, was also naturally significantly different ($P < 0.001$) for sweetness acceptability. When the mean ratings for acceptability of RYGB and SG subjects for each sucrose concentration (2%, 4%, etc.) were compared, there were no significant differences between the two subject groups for all concentration levels, despite the trend of higher ratings for SG subjects for all concentrations, notably for last three sucrose concentrations (20%, 30%, and 40%) (Fig. 2).

Discussion

Our findings revealed a significantly higher sourness threshold, with no significant differences in either the other taste thresholds or acceptability, among RYGB subjects compared with SG subjects. Scruggs et al. obtained a significant increase in sensitivity for sourness at 60 d postoperatively for RYGB compared to baseline values [3]. Both Scruggs et al. [3] and Burge et al. [4] obtained lower thresholds, i.e., higher sensitivity, for sweetness recognition after RYGB. Alterations in food preferences and eating behavior may be secondary to changes in taste acuity after bariatric surgery [4,5]. One mechanism suggested for RYGB is its modulation of the sensory signal by altering its intensity or quality, hence leading to a change in palatability [10].

Table 1
Demographic and anthropometric measurements of subjects

Variable	Roux-en-Y gastric bypass ($n = 9$)	Sleeve gastrectomy ($n = 12$)	*P* value
Sex			0.056*
Males	6 (67)	3 (25)	
Females	3 (33)	9 (75)	
Age (y)	37.0 ± 11.0	28.4 ± 7.2	0.065
Comorbidities†			0.586*
0	5 (56)	9 (75)	
1	2 (22)	2 (17)	
≥2	2 (22)	1 (8)	
Postoperative period (mo)	16.8 ± 14.5	22.8 ± 11.7	0.329
Weight (kg)			
Preoperative	125.6 ± 17.6	115.1 ± 26.9	0.297
Postoperative‡	87.4 ± 21.4	79.2 ± 17.6	0.366
Body mass index (kg/m^2)			
Preoperative	42.8 ± 3.6	41.3 ± 4.7	0.400
Postoperative‡	29.7 ± 5.7	28.6 ± 3.9	0.634

Data are expressed as the mean ± SD or *n* (%)

* *P* value calculated using the χ^2 test.

† Preoperative comorbidities: 0 = none or absence of comorbidities; 1 = presence of one comorbidity; ≥2 = presence of two or more comorbidities.

‡ Mean values 1 y after surgery.