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Effects of Patients Quality of Alimentation on Long-Term Clinical Outcomes After Laparoscopic Adjustable Gastric Band: Prospective-Cohort Clinical Study

Laparoskopik Ayarlanabilir Mide Bandı Sonrası Hastaların Beslenme Kalitelerinin Uzun Dönem Klinik Sonuçlara Etkileri: Prospektif-Kohort Klinik Çalışma

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ABSTRACT Objective: This study, it was aimed to investigate the effect of long-term QA, increasing by nutrition education given by a dietitian, on the clinic (anthropometric measurements and clinical findings) in patients with laparoscopic adjustable gastric band (LAGB) followed by a multidisciplinary team. **Material and Methods:** In this prospective-cohort clinical study, 93 patients after LAGB were followed by bariatric surgery (BS) team for 3 years. Preoperative; general health, comorbidities and nutritional status were evaluated. Demographic information, biochemical parameters and anthropometric measurements were recorded in the patient follow-up form. Preoperative and postoperative diet therapy was given by the dietitian. They were asked to comply with the postoperative follow-up schedules. With a valid and reliable QA form, general satisfaction for the foods consumed, daily main-intermediate meals, food tolerance, vomiting and regurgitation evaluated. The highest score, 27, indicated that QA was the best. Antropometric measurements, biochemical parameters and QA were evaluated. **Results:** At the end of the 3rd year with patients, it was determined that weight loss and excessive body weight loss rate increased ($p<0.05$). It was determined that fasting blood glucose, C-reactive protein, triglyceride, cholesterol, decreased. In the 3rd year, there was a correlation between excessive body weight loss rate ($r=+0.0251$) with QA. Of the biochemical parameters, C-reactive protein, magnesium, high-density lipoprotein, serum iron binding and QA were observed to have a significant correlation. **Conclusion:** Patients were monitored by a BS team were seen to improve food tolerance with increased QA in the long term. The increase in QA was found to have positive effects on the clinic.

Keywords: Quality of alimentation; weight loss; food tolerance; bariatric surgery; long-term clinical outcome

ÖZET Amaç: Bu çalışmada, multidisipliner bir ekiple takip edilen laparoscopic adjustable gastric band (LAGB)'li hastalara, diyetisyen tarafından verilen beslenme eğitimiyle artan uzun dönemli BK'lerinin kliniğe (antropometrik ölçümler ve klinik bulgular) etkisinin araştırılması amaçlandı. **Gereç ve Yöntemler:** Bu prospektif-kohort klinik çalışmada, LAGB sonrası 93 hasta bariatrik cerrahi ekibi tarafından 3 yıl süreyle takip edildi. Cerrahi öncesi genel sağlık, komorbiditeler ve beslenme durumları değerlendirildi. Demografik bilgileri, biyokimyasal parametreleri ve antropometrik ölçümleri hasta takip formuna kaydedildi. Diyetisyen tarafından preop ve postop diyet tedavisi verildi. Cerrahi sonrası takip programlarına uymaları istendi. Geçerlilik ve güvenilirliği yapılan BK formu ile tüketilen besinlere karşı genel tatminkârlık durumu, günlük tüketilen ana-ara öğünler, besin toleransı, kusma-regürjitasyon durumları değerlendirildi. En yüksek puan olan 27, QA'nın en iyi olduğunu gösterdi. Antropometrik ölçümleri, biyokimyasal parametreleri ve BK'leri değerlendirildi. **Bulgular:** Hastaların 3. yılın sonunda ağırlık kaybı ve fazla ağırlığın kaybı yüzdesinin arttığı saptandı ($p<0,05$). Açlık kan şekeri, C-reaktif protein, trigliserid, kolesterol, düşük dansiteli lipoproteinin düştüğü belirlendi. Ilk sırada kırmızı et ve ekmek olmak üzere farklı besinlerin toleransında problemler görüldü. Üçüncü yılda BK puanıyla aşırı vücut ağırlığı kaybı oranı ($r=+0,0251$) arasında korelasyon görüldü. Biyokimyasal parametrelerden C-reaktif protein, magnezyum, yüksek dansiteli lipoprotein, serum demir bağlama kapasitesi ile BK arasında anlamlı korelasyon saptandı. **Sonuç:** Bariatrik cerrahi ekibiyle takip edilen LAGB'li hastaların, uzun dönemde artan BK ile besin toleransının iyileştiği görüldü. Beslenme kalitesindeki artışın kliniğe olumlu etkileri saptandı.

Anahtar Kelimeler: Beslenme kalitesi; ağırlık kaybı; besin toleransı; bariatrik cerrahi; uzun dönem klinik sonuçlar

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Of the bariatric surgery (BS) methods used in 2011 and in 2014, 17.8% and 3%, respectively, were restrictive laparoscopic adjustable gastric band (LAGB) which today is performed laparoscopically.[1-3] However, they increase the risk of nutritional deficiencies, lead to serious changes in eating habits.[4] Weight loss, improving comorbidities, and quality of life are the most important goals of BS. Nutritional and clinical preoperative (pre-op) and postoperative (post-op) evaluation patients by a BS team and lifelong follow-up are required for the success of BS.[1]

Studies show that food intolerance and vomiting cause weight gain as they restrict food intake and cause nutritional deficiencies. Factors affecting weight gain are poor nutritional quality, lack of physical exercise, and inadequate follow-up of nutritional counseling. These show that surgery is not a definitive and stand-alone treatment for the problem of obesity. Surgery is simply a means to reduce calorie intake, digestion, and absorption. Supportive strategies, such as these factors, should always be associated with surgery.[4] The importance of quality of alimentation (QA) is stated in determining the effectiveness of different BS methods and long-term results. It is so far known that food intolerance is higher only in restrictive methods. In all methods, it has been reported that with prolonged post-op time, improvements in food intolerance and QA increase weight loss.[5,6] It was stated that the planning and implementation of proper nutrition treatment for patients by a dietician would lead to increased QA.[1,5] Post-op eating behaviors of patients have a great effect on general health. It has been observed that especially the easy consumption and tolerance of red-white meat, raw-cooked vegetables, bread, rice, pasta and fish increase as the time gets longer.[6] In this study, it was aimed to investigate the effect of long-term QA, which is increased by the nutrition education given by a dietitian, on anthropometric measurements and clinical findings in patients with LAGB who were followed up with the bariatric surgery team.

MATERIAL AND METHODS

STUDY DESIGN AND APPROVAL

This prospective-cohort clinical study was conducted between 2006-2013 on 93 patients aged between 24-57 years, followed routinely in the general surgery clinic, 3 years after LAGB. Follow-up in the clinic is carried out annually after the 1st, 2nd, 3rd, 6th, 9th, 12th month, 1.5 years, and 2nd year. To conduct the study, Ethics Committee Approval (date: 24.12.2020, no: E-10840098-772.02-66598, and decision no. 950) was obtained from Non-Invasive Clinical Research Ethics Committee of the İstanbul Medipol University. The study was performed in accordance with the ethical standards laid down in the 1964 Declaration of Helsinki and its latter amendments. Informed consent was obtained from the patients.

ANTHROPOMETRIC AND BIOCHEMICAL PARAMETERS

In this study, pre-op, and post-op 6 months, 1st year and 3rd years were evaluated. During these periods, demographic information, and biochemical parameters [fasting blood glucose (FBG), hemoglobin A1C (HbA1C), C-reactive protein (CRP), total and ionized calcium, phosphorus, magnesium, albumin, protein, triglycerides (TG), cholesterol, low-density lipoprotein (LDL), high-density lipoprotein (HDL), iron, ferritin, serum iron binding (SIB), vitamin B_{12}, folic acid, insulin] were obtained from the hospital's registration system. Blood samples were taken in the morning on an empty stomach.[7] Nutritional Risk Index (NRI) levels were calculated with the anthropometric measurements taken by dietitian [height and weight, weight loss, excessive body weight loss rate (EWL%), body mass index (BMI), waist, hip, and middle-upper arm circumference (MUAC)] and recorded in the "patient follow-up chart."[8-10] All data obtained prospectively were evaluated retrospectively between 2016-2017.

INCLUSION AND EXCLUSION

Those who have BMI ³40 kg/m² or ³35 kg/m², by the criterions of the 1985 National Institute of Health consensus report and the International Federation for the Surgery of Obesity, and with at least 2 comorbidities were evaluated.[1,11] LAGB was applied with Pars flaccida technique.[12] LAGB is a system developed by Kuzmak and Angrisani (Inamed Health, Santa Barbara, CA).[13,14]

The informing and follow-up of patients about the risks of BS was conducted by the multidisci-

plinary "BS team".[1] Prior to surgery, general health, comorbidities, and nutritional status were evaluated. After surgery, they were asked to comply with follow-up programs.[1,7]

Criteria for inclusion and non-inclusion in the study, management of comorbidities, and diet therapy was done in accordance with the guidelines of the ASMBS. In the pre-operative period, information about post-op diet therapy was given. Protein, vitamin-mineral supplements were recommended to be used.[1,7]

QUALITY OF ALIMENTATION

The QA form developed by Suter et al. was used.[15] 27, the total score of the form, defines the best. Permission to use the form was obtained from Mr. Suter. The data were obtained in the post-op periods determined by the dietician of the clinic.

VALIDITY AND RELIABILITY

Before the study, the QA form in the reference article was translated into Turkish and Turkish into English to check for validity and reliability. Opinions from 6 experts on this issue were obtained and piloting studies were conducted on 20 patients. Upon reading by these 6 experts, it was decided whether it was appropriate and accurate. As a result of the pilot study, the Chronbach alpha value of 0.72 was found and concluded that it was reliable. The scale was administered to 93 people for 3 years.

OPERATIVE TECHNIQUE

Following general anesthesia, asepsis and antisepsis, insufflation was performed to provide 14 mmHg intraabdominal pressure with a verres needle. Five ports were entered and retrogastric tunnel dissection was performed by Pars Flaccida technique. Orogastric tube was orally advanced to the stomach. The balloon was swollen with 15 mL of saline and pulled into the esophagogastric junction. Then, the Pars Flaccida was opened and the retrogastric tunnel was created. With Goldfinger, this tunnel was passed by targeting the incisura cardialis. The connector tip of the gastric band was captured and pulled from the back of the stomach and the gastric band was locked.

Laparoscopic adjustable gastric banding is a restrictive operation. The band has a system that provides weight loss by injecting fluid into a reservoir under the skin and is aimed at reducing appetite. Band adjustments are necessary for success in weight loss. It is deemed necessary to make band adjustments 5-6 times in the first year and 2-3 times in the second year.[13] The LAGB method applied to patients was performed by the same surgeon.

STATISTICAL ANALYSIS

The data analysis was performed using SPSS for Windows, version 22 (IBM, Chicago, IL, USA). The Kolmogorov Smirnov Z test was used to investigate whether the distribution of continuous variables was close to normal. Descriptive statistics were shown as median (minimum-maximum) for continuous variables, and case number and (%) for categorical variables. The significance of dependent samples in terms of means was examined with the paired samples t-test and the significance of the median levels with the Wilcoxon signed ranks test. Friedman two-way Anova test was used in more than 2 dependent non-parametric group variance analysis, while multivariate analysis was used in the analysis of parametric groups. Correlations of the independent variables were performed by Pearson and Spearman's correlation tests. The results for $p<0.05$ were considered statistically significant.

RESULTS

In this clinical study, long-term results of the 93 [82 (88.2%) women, 11 (11.8%) men] patients, to whom the LAGB method was administered with the average age of 36.3±9.2 years, were evaluated.

Weight loss was observed and EWL% increased, and BMI, MUAC, waist and hip circumference and NRI decreased (Table 1). These results were found significant in all periods ($p<0.05$) (Table 2).

Biochemical parameters were in the reference ranges, but FBG, HbA1C, TG, cholesterol, and LDL decreased towards the 3rd year (Table 3). The difference between the periods were given in Table 4.

Daily main course and snack consumption of patients, specific food eating states, were determined (Figure 1, Figure 2). Daily food consumption states the frequency and causes of vomiting were deter-

TABLE 1: Anthropometric measurements in preoperative and postoperative periods.

Anthropometric measurements	Periods			
	Pre-op mean±SD median (minimum-maximum)	Post-op 6th month mean±SD median (minimum-maximum)	1st year mean±SD median (minimum-maximum)	3rd year mean±SD median (minimum-maximum)
Height (cm)	162.8±8.2	162.8±8.2	162.8±8.2	162.8±8.2
Weight (kg)	126.7±23.8	102.5±20.1	91.3±19.2	80.6±19.4
WL (kg)	-	23.9±9.9	35.4±13.8	46.8±22.9
EWL %	-	18.8±6.2	27.6±8.4	36.1±13.2
BMI (kg/m^2)	*47.3±8.1	*38.6±7.0	*34.5±6.7	**30.7±7.5
	45.4 (31.3-72.8)	37.8 (23.5-61.3)	33.9 (21.3-59.2)	28.9 (21.5-53.7)
MUAC (cm)	*42.5±4.4	*37.9±4.4	*35.2±4.5	**32.1±4.3
	42.0 (34.0-57.5)	37.7 (28.0-51.8)	34.7 (25.7-47.0)	30.8 (25.6-47.9)
Waist C (cm)	124.6±16.5	111.0±13.0	103.3±16.5	96.8±13.5
Hip C (cm)	142.9±15.3	130.2±14.4	123.0±14.4	114.2±14.9
NRI	105.4±7.4	97.1±7.1	90.7±9.1	85.6±7.3

*Parametric test; **Non-parametric test; Pre-op: Pre-operative; Post-op: Post-operative; WL: Weight loss; EWL: Excess weight loss; BMI: Body mass index; MUAC: Middle-upper arm circumference; C: Circumference; NRI: Nutritional risk index.

TABLE 2: Statistical difference between periods of anthropometric measurements.

Periods	Weight	WL	BMI	MUAC	Waist C	Hip C	NRI
Pre-op-6th month	p=0.001	p=0.001	p=0.001	p=0.001	p=0.001	p=0.001	p=0.001
Pre-op-1st year	p=0.001	p=0.001	p=0.001	p=0.001	p=0.001	p=0.001	p=0.001
Pre-op-3rd year	p=0.001	p=0.001	*p=0.001	*p=0.001	p=0.001	p=0.001	p=0.001
Post-op 6th month-1st year	p=0.001	p=0.001	p=0.001	p=0.001	p=0.001	p=0.001	p=0.001
Post-op 6th month-3rd year	p=0.001	p=0.001	*p=0.001	*p=0.001	p=0.001	p=0.001	p=0.001
Post-op 1st-3rd year	p=0.001	p=0.001	*p=0.001	*p=0.001	p=0.011	p=0.001	p=0.001

*Non-parametric test; Friedman two-way Anova test; Pre-op: Pre-operative; Post-op: Post-operative; WL: Weight loss; BMI: Body mass index; MUAC: Middle-upper arm circumference; C: Circumference; NRI: Nutritional risk index.

mined. Of the patients, 83 reported that they could not consume every nutrient in the 6th month, 65 in the 1st year, and 36 in the 3rd year. Those who did not vomit daily, often, rarely, and never in the postoperative period were determined that 16, 13, 42, 22 people at 6 months; 8, 6, 33, 46 people at first year; 8, 7, 22, 56 people in the 3rd year. The mean postoperative QA was calculated as 19.8±3.2 [mean (minimum-maximum) 20.0 (12.0-27.0)] at 6 months, 21.9±3.5 [mean (minimum-maximum) 22.0 (14.0-27.0)] at 1 year, and 21.7±4.4 [mean (minimum-maximum) 22.0 (11.0-27.0)] at 3 years. Statistical difference was observed in QA scores of patients between the post-op 6th month-1st year, 6th month and 3rd year (p=0.001), and no difference was observed between the 1st and 3rd year (p=0.836). In the post-op 3rd year, anthropometric measurements of body weight (r=- 0.461, p=0.001), BMI (r=- 0.395, p=0.001), MUAC (r=-0.350, p=0.002), waist (r=- 0.298, p=0.009) and hip circumference (r=- 0.344, p=0.003), EWL% (r=+0.0251, p=0.031) showed a significant correlation with the QA score (Table 5). From biochemical parameters post-op 6 months CRP (r=0.354, p=0.023), magnesium (r=-0.281, p=0.036), and post-op HDL (r=0.359, p=0.010), SIB (r=0.456, p=0.002) and showed correlation with QA. There was no correlation between other parameters and QA (Table 6).

DISCUSSION

Restrictive BS procedures can lead to intolerance of various nutrients, and gastrointestinal disorder (i.e., vomiting), and it is shown that these can affect food

TABLE 3: Biochemical parameters in preoperative and postoperative periods.

Biochemical parameters	Periods			
	Pre-op mean±SD median (minimum-maximum)	Post-op 6th month mean±SD median (minimum-maximum)	1st year mean±SD median (minimum-maximum)	3rd year mean±SD median (minimum-maximum)
FBG 60-100 mg/dL	**103.3±59.9 90 (44-471)	**88.6±23.1 85 (65-233)	**84.3±15.2 82 (65-186)	*83.1±16.5 79 (64-153)
HbA1C 4-6.2%	**6.07±1.27 5.81 (4.32-13.16)	*5.77±0.79 5.64 (4.08-8.44)	*5.68±0.83 5.49 (4.52-10.10)	**5.96±1.84 5.44 (4.08-14.30)
CRP 0-1 mg/L	**16.29±25.70 11.40 (3.02-187.00)	**11.18±12.45 7.17 (0.56-70.60)	*5.99±5.13 3.19 (0.50-23.70)	*8.11±9.09 3.19 (0.50-22.10)
Phosphorus2.5-4.5 mg/dL	*3.3±0.6 3.2 (2.1-4.6)	*3.6±0.5 3.5 (2.7-4.9)	*3.6±0.6 3.6 (2.4-6.1)	*3.5±0.6 3.5 (2.5-5.2)
Magnesium 1.8-2.6 mg/dL	**2.1±0.2 2.1 (1.7-3.1)	*2.1±0.3 2.0 (1.7-3.7)	*2.1±0.2 2.1 (1.8-2.4)	*2.1±0.2 2.1 (1.6-2.5)
Albumin 35-50 g/L	*41.9±4.9 41.0 (30.0-52.0)	*42.0±4.2 41.0 (35.0-54.0)	*40.5±3.7 41.0 (31.0-51.0)	*39.5±3.0 39.0 (32.0-48.0)
Protein 61-79 g/L	**73.5±15.9 73.0 (60.0-214.0)	*72.6±5.4 72.0 (64.0-92.0)	*71.5±4.9 71.0 (62.0-89.0)	*70.4±4.4 69.5 (61.8-81.0)
TG 50-200 mg/dL	**140.6±80.9 115.0 (62.0-673.0)	*110.4±49.4 98.0 (41.0-303.0)	*92.5±40.4 84.0 (27.0-236.0)	*82.2±34.8 81.5 (30.0-211.0)
Cholesterol 0-200 mg/dL	*195.3±34.6 196.0 (123.0-277.0)	*187.1±41.8 181.0 (34.0-334.0)	*186.2±41.5 179.5 (102.0-368.0)	*181.1±40.3 180.0 (98.0-328.0)
LDL 0-100 mg/dL	*127.8±36.5 119 (63.0-276.0)	*126.7±32.7 121.0 (56.0-246.0)	*121.7±37.9 117.5 (49.0-286.0)	*117.7±32.0 117.0 (47.0-230.8)
HDL 35-85 mg/dL	*42.7±9.9 42.0 (24.0-67.0)	*42.3±8.5 42.5 (24.0-61.0)	*46.3±9.0 46.3 (25.0-64.5)	*48.0±12.3 46.5 (22.0-74.2)
Iron 28-170 µg/dL	*60.9±27.9 57.0 (6.0-144.0)	*63.5±31.3 61.0 (10.0-158.0)	*65.6±33.3 59.0 (17.0-157.0)	*69.4±40.1 63.0 (15.0-208.0)
Ferritin 11-306 ng/mL	**38.3±35.3 29.4 (4.2-230.7)	**30.3±30.8 24.5 (3.0-155.6)	**30.5±28.7 23.3 (2.8-122.4)	**26.0±26.4 14.8 (2.7-108.7)
SIB 126-382 µg/dL	*325.8±84.0 317.5 (189.0-573.0)	*296.4±73.0 297.0 (140.0-436.0)	*293.6±75.8 297.5 (105.0-473.0)	*309.2±83.5 297.0 (170.0-521.0)
B12 126.5-505 pg/mL	*209.0±99.7 189.0 (2.1-672.0)	*244.4±115.9 222.0 (84.0-781.0)	*243.7±138.4 210.0 (68.0-886.0)	*227.6±123.4 203.0 (74.0-668.0)
Folic acid >2.5 ng/mL	**7.3±11.1 5.5 (2.7-99.0)	*6.9±4.2 5.9 (1.7-19.4)	*5.6±2.7 5.2 (1.3-14.3)	*6.6±3.5 6.6 (1.7-20.0)
Insulin 1.9-23 µIU/mL	**20.8±16.6 15.6 (5.1-79.3)	*8.9±4.3 8.5 (2.7-21.0)	*9.4±12.0 6.5 (2.0-85.5)	*6.7±4.7 5.1 (1.9-25.4)

*Parametric test; **Non-parametric test; FBG: Fasting blood glucose; HbA1C: Hemoglobin A1C; CRP: C-reactive protein; TG: Triglycerides; LDL: Low-density lipoprotein; HDL: High-density lipoprotein; SIB: Serum iron binding.

choices and eating behavior.[16] Due to having low mortality and complications, being a simple, safe, and reversible operation, doctors and patients prefer LAGB.[6,16]

In this study, the effect of long-term QA, which is increased by nutrition education given by a dietitian, on anthropometric measurements and biochemical parameters of patients followed up with a multidisciplinary bariatric surgery team in the long term after LAGB was evaluated. In studies with similar methodology, weight loss of patients with LAGB was found to be 11.7-14.5 kg less than our loss at the end of 1 year.[17,18] In one study, it was reported that the weight loss in the 3rd year was half as much as ours (p=0.01).[19] Loss of 50% of EWL% after operation is shown as success.[4] At the 2004 ASMBS Con-

TABLE 4: Difference between biochemical parameters in preoperative and postoperative periods.

Biochemical parameters	Pre-op/ post-op 6th month	Pre-op/post-op 1st year	Pre-op/post-op 3rd year	Post-op 6th month/1st year	Post-op 6th month/3rd year	Post-op 1st/3rd year
FBG 60-100 mg/dL	**p=0.002**	**p=0.001**	**p=0.001**	**p=0.036**	p=0.082	p=0.477
HbA1C 4-6.2%	p=0.282	p=0.867	p=0.532	p=0.778	p=0.640	p=0.280
CRP 0-1 mg/L	p=0.052	**p=0.001**	p=0.180	**p=0.002**	p=0.523	p=0.686
Phosphorus 2.5-4.5 mg/dL	**p=0.004**	**p=0.012**	p=0.164	p=0.980	p=0.735	p=0.650
Magnesium 1.8-2.6 mg/dL	p=0.411	p=0.528	p=0.666	p=0.794	p=0.605	p=0.860
Albumin 35-50 g/L	p=0.168	**p=0.001**	**p=0.007**	**p=0.001**	**p=0.003**	p=0.259
Protein 61-79 g/L	p=0.861	p=0.191	**p=0.033**	p=0.149	**p=0.044**	p=0.089
TG 50-200 mg/dL	**p=0.001**	**p=0.001**	**p=0.001**	**p=0.046**	**p=0.003**	**p=0.031**
Cholesterol 0-200 mg/dL	p=0.085	p=0.143	**p=0.015**	p=0.679	p=0.680	p=0.472
LDL0-100 mg/dL	p=0.403	p=0.515	**p=0.045**	p=0.501	p=0.556	p=0.346
HDL 35-85 mg/dL	p=0.351	p=0.147	**p=0.005**	**p=0.008**	**p=0.001**	**p=0.026**
Iron 28-170 µg/dL	p=0.082	p=0.081	p=0.088	p=0.432	p=0.700	p=0.851
Ferritin 11-306 ng/mL	p=0.475	p=0.175	**p=0.019**	p=0.187	p=0.065	**p=0.016**
SIB 126-382 µg/dL	**p=0.048**	**p=0.023**	p=0.080	p=0.261	**p=0.010**	p=0.087
B12 126.5-505 pg/mL	**p=0.039**	p=0.079	p=0.104	p=0.548	p=0.524	p=0.131
Folic acid >2.5 ng/mL	p=0.449	p=0.170	p=0.396	**p=0.027**	p=0.630	p=0.522
Insulin 1.9-23 µIU/mL	**p=0.001**	**p=0.001**	**p=0.001**	**p=0.001**	**p=0.005**	**p=0.087**

Friedman two-way Anova test; FBG: Fasting blood glucose; HbA1C: Hemoglobin A1C; CRP: C-reactive protein; TG: Triglycerides; LDL: Low-density lipoprotein; HDL: High-density lipoprotein; SIB: Serum iron binding.

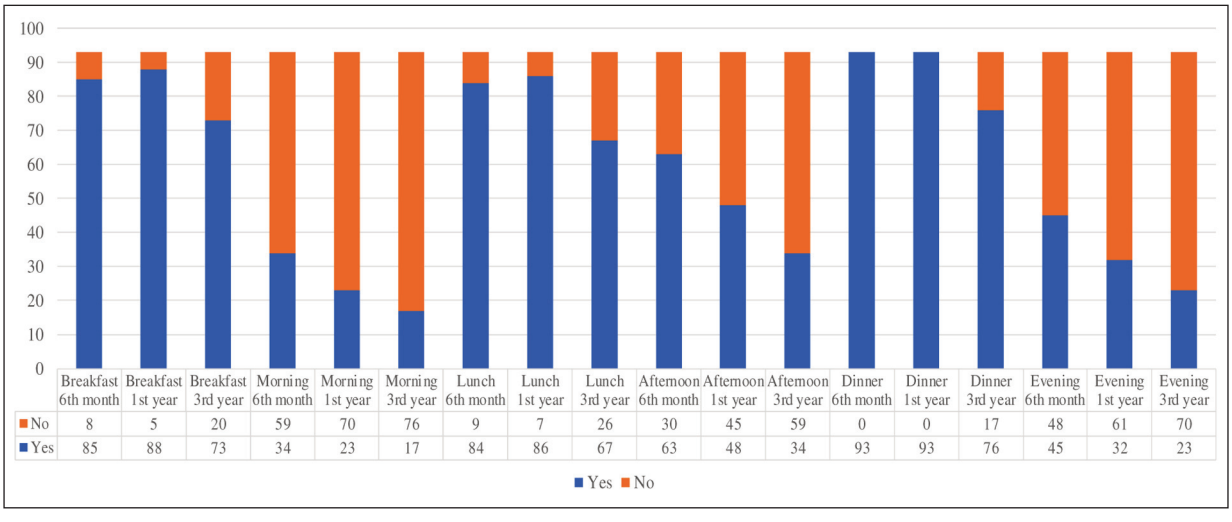
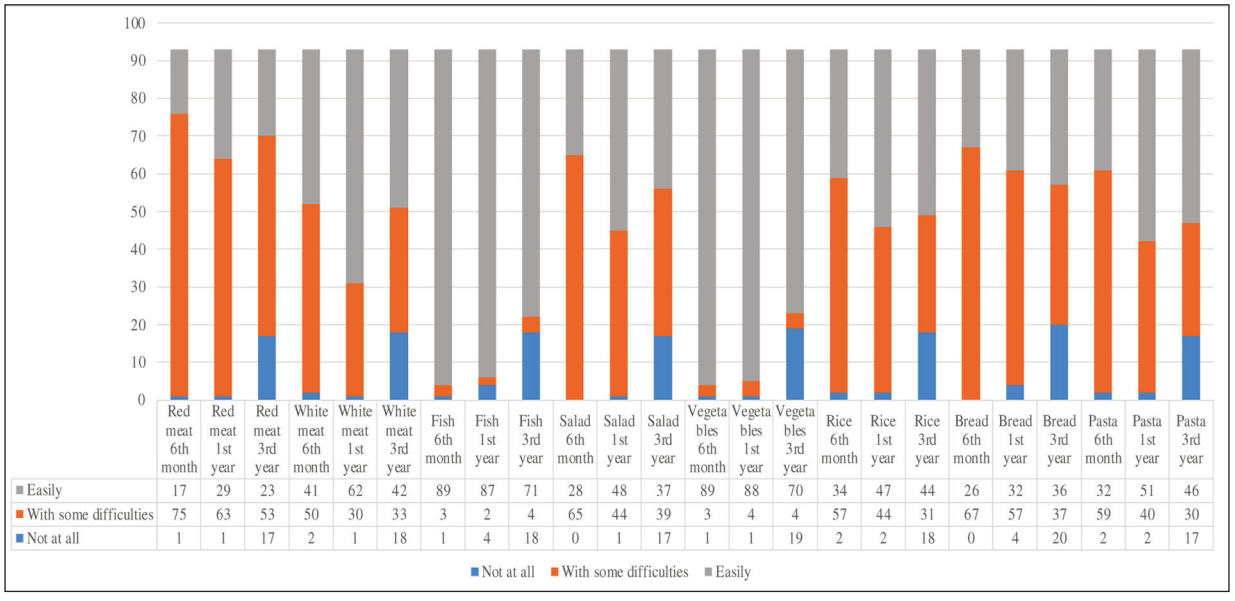


FIGURE 1: Quality of alimentation: Daily main-intermediate meal consumptions in postoperative periods.

sensus Conference, 50-60% of EWL% were reported to be lost in LAGB at the end of the 2nd and 3rd years.[20] Our study lags the predicted success with 36% of EWL% at the end of the post-op 3rd year (Table 1). McGrice et al, achieved this success in the 2nd year, but they found that by the 5th year EWL% (47.2%) decreased over time.[21] In similar studies, EWL% was 2.1-14.00% more than our study in the 3rd year, but none of them were able to reach 50-60 EWL% reported at the 2004 American Society for Metabolic & Bariatric Surgery Consensus Conference.[19,21-24]

In studies, reductions in BMI (1st and 3rd year), waist and hip circumferences were found to be similar to our study.[10,17,19,24-26] In the 3rd year, it was ob-



	Red meat 6th month	Red meat 1st year	Red meat 3rd year	White meat 6th month	White meat 1st year	White meat 3rd year	Fish 6th month	Fish 1st year	Fish 3rd year	Salad 6th month	Salad 1st year	Salad 3rd year	Vegetables 6th month	Vegetables 1st year	Vegetables 3rd year	Rice 6th month	Rice 1st year	Rice 3rd year	Bread 6th month	Bread 1st year	Bread 3rd year	Pasta 6th month	Pasta 1st year	Pasta 3rd year
Easily	17	29	23	41	62	42	89	87	71	28	48	37	89	88	70	34	47	44	26	32	36	32	51	46
With some difficulties	75	63	53	50	30	33	3	2	4	65	44	39	3	4	4	57	44	31	67	57	37	59	40	30
Not at all	1	1	17	2	1	18	1	4	18	0	1	17	1	1	19	2	2	18	0	4	20	2	2	17

FIGURE 2: Quality of alimentation: Specific food eating in postoperative periods.

TABLE 5: The correlations of quality of alimentation score with anthropometric measurements.

		Quality of alimentation score					
		Post-op 6th month		Post-op 1st year		Post-op 3rd year	
Anthropometric measurements	Post-op	r value	p value	r value	p value	r value	p value
		-	-	-	-	-	-
Weight	6th month	-0.133	0.205	-	-	-	-
	1st year	-	-	-0.142	0.176	-	-
	3rd year	-	-	-	-	**-0.461**	**0.001**
WL	6th month	+0.069	0.514	-	-	-	-
	1st year	-	-	-0.032	0.760	-	-
	3rd year	-	-	-	-	+0.227	0.052
EWL%	6th month	+0.148	0.156	-	-	-	-
	1st year	-	-	-0.023	0.827	-	-
	3rd year	-	-	-	-	**+0.0251**	**0.031**
BMI	6th month	-0.173	0.484	-	-	-	-
	1st year	-	-	-0.077	0.462	-	-
	3rd year	-	-	-	-	**-0.395**	**0.001**
MUAC	6th month	-0.048	0.652	-	-	-	-
	1st year	-	-	-0.046	0.664	-	-
	3rd year	-	-	-	-	**-0.350**	**0.002**
Waist C	6th month	-0.079	0.461	-	-	-	-
	1st year	-	-	+0.143	0.173	--	-
	3rd year	-	-	-	-	**-0.298**	**0.009**
Hip C	6th month	-0.161	0.129	-	-	-	-
	1st year	-	-	-0.057	0.588	-	-
	3rd year	-	-	-	-	**-0.344**	**0.003**
NRI	6th month	-0.056	0.656	-	-	-	-
	1st year	-	-	+0.068	0.575	-	-
	3rd year	-	-	-	-	-0.214	0.153

Pearson and Spearman's correlation test; Post-op: Post-operative; WL: Weight loss; EWL: Excess weight loss; BMI: Body mass index; MUAC: Middle-upper arm circumference; C: Circumference; NRI: Nutritional risk index.

TABLE 6: Quality of alimentation score between periods biochemical parameters.

		Quality of alimentation score					
		Post-op 6th month		Post-op 1st year		Post-op 3rd year	
Biochemical parameters		r value	p value	r value	p value	r value	p value
	Post-op	-	-	-	-	-	-
FBG 60-100 mg/dL	6th month	0.116	0.357	-	-	-	-
	1st year	-	-	0.050	0.686	-	-
	3rd year	-	-	-	-	0.017	0.903
HbA1C 4-6.2%	6th month	-0.102	0.432	-	-	-	-
	1st year		--	0.125	0.332	-	-
	3rd year	-	-	-	-	0.041	0.798
CRP 0-1 mg/L	6'h month	**0.354**	**0.023**	-	-	-	-
	1st year	-	-	0.155	0.390	-	-
	3rd year	-	-	-	-	-0.209	0.838
Phosphorus 2.5-4.5 mg/dL	6th month	-0.018	0.892	-	-	-	-
	1st year	-	-	-0.070	0.599	-	-
	3rd year	-	-	-	-	-0.037	0.812
Magnesium 1.8-2.6 mg/dL	6th month	**-0.281**	**0.036**	-	-	-	-
	1st year	-	-	-0.008	0.950	-	-
	3rd year	-	-	-	-	0.038	0.809
Albumin 35-50 g/L	6th month	-0.106	0.400	-	-	-	-
	1st year	-	-	-0.031	0.803	-	-
	3rd year	-	-	-	-	-0.073	0.613
Protein 61-79 g/L	6th month	0.059	0.636	-	-	-	-
	1st year	-	-	0.017	0.887	-	-
	3rd year	-	-	-	-	0.063	0.662
TG 50-200 mg/dL	6th month	0.094	0.462	-	-	-	-
	1st year	-	-	0.046	0.718	-	-
	3rd year	-	-	-	-	-0.023	0.888
Cholesterol 0-200 mg/dL	6th month	0.141	0.263	-	-	-	-
	1st year	-	-	0.171	0.177	-	-
	3rd year	-	-	-	-	0.162	0.262
LDL 0-100 mg/dL	6th month	0.043	0.734	-	-	-	-
	1st year	-	-	0.117	0.358	-	-
	3rd year	-	-	-	-	0.109	0.452
HDL 35-85 mg/dL	6th month	0.100	0.434	-	-	-	-
	1st year	-	-	0.242	0.054	-	-
	3rd year	--	-	-	-	**0.359**	**0.010**
Iron 28-170 µg/dL	6th month	-0.123	0.333	-	-	-	-
	1st year	-	-	-0.003	0.983	-	-
	3rd year	-	-	-	-	-0.191	0.203
Ferritin 11-306 ng/mL	6th month	0.152	0.242	-	-	-	-
	1st year	-	-	-0.045	0.725	-	-
	3rd year	-	-	-	-	-0.227	0.125
SIB 126-382 µg/dL	6th month	0.096	0.472	-	-	-	-
	1st year	-	-	0.097	0.462	-	-
	3rd year	-	-	-	-	**0.456**	**0.002**
B12 126.5-505 pg/mL	6th month	0.001	0.998	-	-	-	-
	1st year	-	-	-0.052	0.683	-	-
	3rd year	-	-	-	-	-0.048	0.744
Folic acid >2.5 ng/mL	6th month	0.058	0.654	-	-	-	-
	1st year	-	-	0.221	0.085	-	-
	3rd year	-	-	-	-	0.239	0.127
Insulin 1.9-23 µIU/mL	6th month	-0.004	0.980	-	-	-	-
	1st year	-	-	0.128	0.362	-	-
	3rd year	-	-	-	-	-0.004	0.980

Pearson and Spearman's correlation test; FBG: Fasting blood glucose; HbA1C: Hemoglobin A1C; CRP: C-reactive protein; TG: Triglycerides; LDL: Low-density lipoprotein; HDL: High-density lipoprotein; SIB; Serum iron binding.

served that the waist circumference approached the required values.

In the following 6 months, NRI was developed as a prognostic indicator for the emerging complications and mortality after roux en-Y gastrik bypass (RYGB). In our study, our patients with normal NRI in the pre-op period were within the limits in the 6th month of post-op and middle-level malnutrition in the 1st and 3rd year (p=0.000).[8]

Poor diet quality, lack of physical exertion and insufficient nutrition counseling follow-up are factors affecting weight gain. They show that surgery is not a definite and solitary treatment for the problem of obesity. The operation is only a means for reducing caloric intake, digestion, and absorption. Supportive strategies, such as these factors, as always mentioned, should be associated with surgery.[4]

The post-op eating behavior of patients has a great impact on overall health. It was determined that the evening meals increased whilst snacks decreased towards the 3rd year (Figure 1). The study that supported our results shows that our main meals were similar, while snacks were 2-3 times more.[27] The proportion of nutrients that our patients could not eat decreased towards the 3rd year.

When the specific food that were consumed with some difficulties from the most difficult to the easiest were ranked, they were red meat, bread, salad, and rice-pasta. It was found that red meat was mostly easier to consume as minced meat/meatballs. When LAGB was compared with different methods, in which red and white meat, vegetables, bread, rice, pasta and fish were difficult to eat and therefore caused vomiting more, our patients could easily consume vegetables and fish (Figure 2). Easy consumption and tolerance of these eight foods increased as the duration was extended.[15,22,23,27-29]

It was found that 38.3% of our patients who consumed red meat with some difficulty, consumed approximately 50% easier with RYGB. Fish and vegetables, of the easily tolerated food, were found to be similar to patients with RYGB.[27]

Similar to our results, low scores were obtained for salad, bread, pasta, vegetables, and fish in patients with sleeve gastrectomy (SG) (p=0.04).[5] In another study conducted in patients with SG, it was determined that fish, vegetables, and white meat were easily tolerated in all periods.[30]

In the literature, food tolerance (FT) and QA were found bad in the first year as we had. According to the methods, FT and QA were ranked from most to least as biliopancreatic diversion with duodenal switch, RYGB, vertical band gastrectomy, SG and LAGB. These results confirmed the hypothesis that impaired absorption and mixed methods increased FT, while other studies found that SG showed better FT in the post-op period. In our case, as in all methods, it was observed that QA increased with long-term follow-up and was higher than the score obtained from studies using the same methodology (p<0.05). The type of surgery was also shown to be effective in the outcome.[5,15,16,22,23,29-32]

Another study reported that QA deteriorated over time after LAGB, and EWL% and post-op time on QA were effective.[5] In other RYGB patients, their QA was 1.3-2.3 units more than ours.[5,33] With a QA score of 22-24.2 in different methods, they seemed to be 2.2 more than our study.[15,22,27,29] Because of the malabsorptive method, it was expected to be found higher. We found that the QA score of our patients was higher than their patients with LAGB.[5] The authors hypothesized that complications such as LAGB being a restrictive and adjustable method, reducing nutrient tolerance, possible inflammation due to foreign material, and dislocation/wearing of the band may cause poor performance.[5,15,23]

In the post-op 3rd year, QA was found to increase as anthropometric measurement levels decreased, except for EWL%. As time progresses, EWL% has increased, and this increase has improved QA (Table 5).

In addition, HDL and SIB levels were increased as QA increased. This is an expected positive result.[17,25] From inflammatory markers, when the CRP level was very high, the QA score was low, and over time, the QA improved as the CRP level fell. This is also a desired positive result (Table 6).[17]

It was reported that LAGB patients with a reduced gastric pouch vomited when they did not chew

food well, and this was higher than those with RYGB and SGs. ($p<0.001$).[22,23,30,34] Rarely vomiting rate was 48.9%, which was less in our findings, and those who never vomited were 42.6%, which was more in us. Daily and frequent vomiting was found to be very low in our study with 6.5-17.1%.[5] de Zwaan et al. noted that 30.5% of RYGB followed between 18-35 months had difficulty chewing, and 60% had vomiting.[35] In the same duration, these were observed in our patients at lower rates. "Poor chewing (40.9% in 6th month, 22.6% per year, 12.9% in 3rd year)" was presented as the first stated cause of vomiting, followed by "consumption of liquid with food (6.5% in the 6th month, 0.0% per year, 1.1% per year)." de A Godoy et al. found an important and direct proportional relationship with QA, as the chewing period grew longer.[33]

As in our study, increased post-op follow-up, implementation of a treatment protocol by paying attention to solid-liquid separation, meatballs-minced meat, very small pieces of mashed food and thoroughly chewing may facilitate eating, and may also prevent and/or reduce nausea/vomiting. Hence, the QA increases.[27] The main purpose of chewing is to prevent gagging. Vomiting, which develops due to changing anatomy and difficulties in the ingestion of certain food groups, can lead to a longer consumption of semi-liquid and soft food. Such food also causes excess weight gain in 20% of patients over a long period of time, since they contain simple carbohydrates, rather than protein. In such cases, the FTs of LAGB are even lower than those with RYGB and SGs.[22,23,27] Protein-containing red meat is difficult to digest and tolerate due to anatomical and physiological changes in post-op gastrointestinal system. Most patients cannot eat it. In this case, some nutritional deficiencies are formed.[15,22,27,29]

For these reasons, the evaluation of FT and QA is reported to be crucial in reducing the risk of post-op nutritional deficiency, determining food groups and substances, evaluating long-term results, choosing the BS method, observing patients, developing treatment protocols, and preparing the patient for the results of the surgery in the pre-op period. Decrease in eating quality is important in all methods. The reasons that reduce nutrient tolerance and QA have different mechanisms. These are 8 foods that are difficult to tolerate, weight gain from a sudden improvement in FT as a result of leakage or erosion in the LAGB, and tightness of the band.[5,15,22,27,35]

The post-LAGB stoma setting needs to be done correctly. Otherwise, FT and QA will be positively affected, causing weight loss, or negatively affected, causing weight gain. If weight loss is insufficient, the band should be tightened. If the band is too tight, then QA and FTs are usually weak. In the case of band shift or expansion of the esophagus, the band needs to be loosened. These situations are the reason for switching to a high-calorie semi-liquid diet, which results in paradoxical weight gain.[15] As in our study, both surgery and dietitian intervention have an effect on changes in food preference and eating behavior. With these changes, post-operative calories are restricted, and weight loss occurs.[30]

In our study, when compared to others, patients having high QA, excess weight losses, improvements in meals and food consumption, and post-op adaptation are associated with the self-monitoring of patients, as well as frequent nutritional counseling, education, and diet follow-up given on a regular, continuous, and face to face basis by our multidisciplinary team and the dietician. This may be the result of successful dietary counseling and high adherence to dietary advice.[5,16,22,27,28,30,31]

STRENGTHS AND WEAKNESSES OF THE STUDY

The data were obtained by the team's dietician by interviewing patients face to face in certain periods. We believe this caused information obtained to be more reliable and a higher QA score. That's the strength of our work. Our other strengths are the 3-year follow-up period, and the correlation between anthropometric and biochemical parameters and QA, which we have not encountered in the literature. Our weakness is that we could not compare it with other surgical procedures.

In the future, the long-term results of the impact of the training on QA, which reveals the importance of face-to-face follow-up with the team in all methods, should be evaluated. Biochemical parameters and correlations between complications and QA should be examined. Further research is required to

assess the relationship between nutritional deficiencies and QA.

CONCLUSION

It was determined that periodic and regular nutrition education given by a dietitian to LAGB patients followed up with a multidisciplinary team had positive effects on both anthropometric and biochemical parameters by increasing QA.

Source of Finance

During this study, no financial or spiritual support was received neither from any pharmaceutical company that has a direct connection with the research subject, nor from a company that provides or produces medical instruments and materials which may negatively affect the evaluation process of this study.

Conflict of Interest

No conflicts of interest between the authors and / or family members of the scientific and medical committee members or members of the potential conflicts of interest, counseling, expertise, working conditions, share holding and similar situations in any firm.

Authorship Contributions

Idea/Concept: *Nihal Zekiye Erdem, Fatih Mehmet Avşar;* ***Design:*** *Nihal Zekiye Erdem, Fatih Mehmet Avşar;* ***Control/Supervision:*** *Nihal Zekiye Erdem, Fatih Mehmet Avşar;* ***Data Collection and/or Processing:*** *Nihal Zekiye Erdem, Fatih Mehmet Avşar;* ***Analysis and/or Interpretation:*** *Nihal Zekiye Erdem, Fatih Mehmet Avşar;* ***Literature Review:*** *Nihal Zekiye Erdem;* ***Writing the Article:*** *Nihal Zekiye Erdem, Fatih Mehmet Avşar;* ***Critical Review:*** *Nihal Zekiye Erdem, Fatih Mehmet Avşar;* ***References and Fundings:*** *Nihal Zekiye Erdem, Fatih Mehmet Avşar;* ***Materials:*** *Nihal Zekiye Erdem, Fatih Mehmet Avşar.*

REFERENCES

1. Mechanick JI, Apovian C, Brethauer S, Garvey WT, Joffe AM, Kim J, et al. Clinical practice guidelines for the perioperative nutrition, metabolic, and nonsurgical support of patients undergoing bariatric procedures-2019 update: cosponsored by American Association of Clinical Endocrinologists/American College of Endocrinology, The Obesity Society, American Society for Metabolic & Bariatric Surgery, Obesity Medicine Association, and American Society of Anesthesiologists. Surg Obes Relat Dis. 2020;16(2):175-247. [Crossref] [PubMed]
2. Buchwald H, Oien DM. Metabolic/bariatric surgery worldwide 2011. Obes Surg. 2013;23(4):427-36. [Crossref] [PubMed]
3. Via MA, Mechanick JI. Nutritional and micronutrient care of bariatric surgery patients: current evidence update. Curr Obes Rep. 2017;6(3):286-96. [Crossref] [PubMed]
4. Freire RH, Borges MC, Alvarez-Leite JI, Toulson Davisson Correia MI. Food quality, physical activity, and nutritional follow-up as determinant of weight regain after Roux-en-Y gastric bypass. Nutrition. 2012;28(1):53-8. [Crossref] [PubMed]
5. Schweiger C, Weiss R, Keidar A. Effect of different bariatric operations on food tolerance and quality of eating. Obes Surg. 2010;20(10):1393-9. [Crossref] [PubMed]
6. Figueiredo Reis GM, Malheiros CA, Savassi-Rocha PR, Cançado Júnior OL, Thuler FR, Faria ML, et al. Gastric emptying and food tolerance following banded and non-banded roux-en-Y gastric bypass. Obes Surg. 2019;29(2):560-8. [Crossref] [PubMed]
7. Fried M, Hainer V, Basdevant A, Buchwald H, Deitel M, Finer N, et al; Bariatric Scientific Collaborative Group Expert Panel. Interdisciplinary European guidelines for surgery for severe (morbid) obesity. Obes Surg. 2007;17(2):260-70. [Crossref] [PubMed]
8. Buzby GP, Knox LS, Crosby LO, Eisenberg JM, Haakenson CM, McNeal GE, et al. Study protocol: a randomized clinical trial of total parenteral nutrition in malnourished surgical patients. Am J Clin Nutr. 1988;47(2 Suppl):366-81. [Crossref] [PubMed]
9. Bishop CW, Bowen PE, Ritchey SJ. Norms for nutritional assessment of American adults by upper arm anthropometry. Am J Clin Nutr. 1981;34(11):2530-9. [Crossref] [PubMed]
10. World Health Organization. Waist circumference and waist-hip ratio. Report of a WHO expert consultation. Relationships of waist circumference and waist-hip ratio to disease risk and mortality. World Health Organization; 2011. p.12-8. [Link]
11. Gastrointestinal surgery for severe obesity: National Institutes of Health Consensus Development Conference Statement. Am J Clin Nutr. 1992;55(2 Suppl):615S-9S. [Crossref] [PubMed]
12. Fielding GA, Allen JW. A step-by-step guide to placement of the LAP-BAND adjustable gastric banding system. Am J Surg. 2002;184(6B):26S-30S. [Crossref] [PubMed]
13. Angrisani L, Vitiello A, Santonicola A, Hasani A, De Luca M, Iovino P. Roux-en-Y gastric bypass versus sleeve gastrectomy as revisional procedures after adjustable gastric band: 5-year outcomes. Obes Surg. 2017;27(6):1430-7. [Crossref] [PubMed]
14. Busetto L, Valente P, Pisent C, Segato G, de Marchi F, Favretti F, et al. Eating pattern in the first year following adjustable silicone gastric banding (ASGB) for morbid obesity. Int J Obes Relat Metab Disord. 1996;20(6):539-46. [PubMed]
15. Suter M, Calmes JM, Paroz A, Giusti V. A new questionnaire for quick assessment of food tolerance after bariatric surgery. Obes Surg. 2007;17(1):2-8. [Crossref] [PubMed]
16. Kafri N, Valfer R, Nativ O, Shiloni E, Hazzan D. Health behavior, food tolerance, and satisfaction after laparoscopic sleeve gastrectomy. Surg Obes Relat Dis. 2011;7(1):82-8. [Crossref] [PubMed]
17. Sakçak I, Avşar MF, Hamamci EO, Bostanoğlu S, Sonişik M, Bostanoğlu A, et al. Comparison of early and late changes in immunoglobulins and acute phase reactants after laparoscopic adjustable gastric banding in patients with morbid obesity. Obes Surg. 2010;20(5):610-5. [Crossref] [PubMed]
18. Favretti F, Segato G, Ashton D, Busetto L, De Luca M, Mazza M, et al. Laparoscopic adjustable gastric banding in 1,791 consecutive obese patients: 12-year results. Obes Surg. 2007;17(2):168-75. [Crossref] [PubMed]

19. Burton PR, Ooi GJ, Laurie C, Anderson M, Parker K, Paul E, et al. Changes in outcomes, satiety and adverse upper gastrointestinal symptoms following laparoscopic adjustable gastric banding. Obes Surg. 2017;27(5):1240-9. [Crossref] [PubMed]

20. Ponce J, Dixon JB; 2004 ABS Consensus Conference. Laparoscopic adjustable gastric banding. Surg Obes Relat Dis. 2005;1(3):310-6. [Crossref] [PubMed]

21. McGrice M, Don Paul K. Interventions to improve long-term weight loss in patients following bariatric surgery: challenges and solutions. Diabetes Metab Syndr Obes. 2015;8:263-74. [Crossref] [PubMed] [PMC]

22. Freeman RA, Overs SE, Zarshenas N, Walton KL, Jorgensen JO. Food tolerance and diet quality following adjustable gastric banding, sleeve gastrectomy and Roux-en-Y gastric bypass. Obes Res Clin Pract. 2014;8(2):e115-200. [Crossref] [PubMed]

23. Overs SE, Freeman RA, Zarshenas N, Walton KL, Jorgensen JO. Food tolerance and gastrointestinal quality of life following three bariatric procedures: adjustable gastric banding, Roux-en-Y gastric bypass, and sleeve gastrectomy. Obes Surg. 2012;22(4):536-43. [Crossref] [PubMed]

24. Lee WJ, Lee YC, Ser KH, Chen JC, Chen SC. Improvement of insulin resistance after obesity surgery: a comparison of gastric banding and bypass procedures. Obes Surg. 2008;18(9):1119-25. [Crossref] [PubMed]

25. Sakcak İ, Avşar FM, Erdem NZ, Hamamacı EO, Bostanoglu S, Sonisik M, et al. Changes in comorbid diseases in morbidly obese patients treated by laparoscopic adjustable gastric banding. Pak J Med Sci. 2010;26(1):6-10. [PubMed]

26. Pontiroli AE, Pizzocri P, Librenti MC, Vedani P, Marchi M, Cucchi E, et al. Laparoscopic adjustable gastric banding for the treatment of morbid (grade 3) obesity and its metabolic complications: a three-year study. J Clin Endocrinol Metab. 2002;87(8):3555-61. [Crossref] [PubMed]

27. Godoy CM, Caetano AL, Viana KR, Godoy EP, Barbosa AL, Ferraz EM. Food tolerance in patients submitted to gastric bypass: the importance of using an integrated and interdisciplinary approach. Obes Surg. 2012;22(1):124-30. [Crossref] [PubMed]

28. Ernst B, Thurnheer M, Wilms B, Schultes B. Differential changes in dietary habits after gastric bypass versus gastric banding operations. Obes Surg. 2009;19(3):274-80. [Crossref] [PubMed]

29. Cano-Valderrama O, Sánchez-Pernaute A, Rubio-Herrera MA, Domínguez-Serrano I, Torres-García AJ. Long-term food tolerance after bariatric surgery: comparison of three different surgical techniques. Obes Surg. 2017;27(11):2868-72. [Crossref] [PubMed]

30. Coluzzi I, Raparelli L, Guarnacci L, Paone E, Del Genio G, le Roux CW, et al. Food intake and changes in eating behavior after laparoscopic sleeve gastrectomy. Obes Surg. 2016;26(9):2059-67. [Crossref] [PubMed]

31. Stumpf MA, Rodrigues MR, Kluthcovsky AC, Travalini F, Milléo FQ. Analysis of food tolerance in patients submitted to bariatric surgery using the questionnaire quality of alimentation. Arq Bras Cir Dig. 2015;28 Suppl 1(Suppl 1):79-83. [Crossref] [PubMed] [PMC]

32. Suter M, Giusti V, Worreth M, Héraief E, Calmes JM. Laparoscopic gastric banding: a prospective, randomized study comparing the Lapband and the SAGB: early results. Ann Surg. 2005;241(1):55-62. [Crossref] [PubMed] [PMC]

33. de A Godoy CM, Aprígio LCS, de Godoy EP, Furtado MC, Coelho D, de Souza LBR, et al. Food tolerance and eating behavior after roux-en-Y gastric bypass surgery. Obes Surg. 2018;28(6):1540-5. [Crossref] [PubMed]

34. Lee WJ, Wang W, Yu PJ, Wei PL, Huang MT. Gastrointestinal quality of life following laparoscopic adjustable gastric banding in Asia. Obes Surg. 2006;16(5):586-91. [Crossref] [PubMed]

35. de Zwaan M, Hilbert A, Swan-Kremeier L, Simonich H, Lancaster K, Howell LM, et al. Comprehensive interview assessment of eating behavior 18-35 months after gastric bypass surgery for morbid obesity. Surg Obes Relat Dis. 2010;6(1):79-85. [Crossref] [PubMed]