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EVALUATION OF THE RESULTS OF BIOELECTRICAL IMPEDANCE ANALYSIS IN PATIENTS UNDERGOING LAPAROSCOPIC SLEEVE GASTRECTOMY AND ITS EFFECT ON POSTOPERATIVE FOLLOW-UP

LAPAROSKOPİK SLEEVE GASTREKTOMİ UYGULANAN HASTALARDA BİYOELEKTRİK EMPEDANS ANALİZİ SONUÇLARININ DEĞERLENDİRİLMESİ VE POSTOPERATİF TAKİBE ETKİSİ

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ABSTRACT

AIM: Obesity is a health problem. Laparoscopic sleeve gastrectomy (LSG) surgery is the most widely used surgical method in the treatment of obesity. Post-LSG follow-up is as important as the surgery itself. This study aims to examine the most accurate way to follow in the postoperative follow-up of LSG by examining the changes in body compositions such as fat and muscle.

MATERIAL AND METHOD: 19 female patients who underwent LSG surgery by a single surgeon in Kırşehir Training and Research Hospital between September 2019 and March 2020 were included in our study. The mean age of the patients was 35.73 years. The mean body mass index (BMI) was 43.03. Bioelectric impedance analysis was performed on the patients before the surgery, at the 1st and 2nd months after the surgery. Statistical evaluation of the results was performed.

RESULTS: Many undesirable values such as weight, BMI, and fat were significantly reduced ($p<0.05$). However, no significant values were obtained in mineral, protein, and fluid values, especially in the 2nd month measurements ($p=0.582$, $p=0.160$, $p=0.376$, respectively). Statistically insignificant values were obtained in the 2nd month measurements in the right and left leg and left arm muscles when extremity muscle values were examined ($p=0.431$, $p=0.132$, $p=0.413$, respectively). There was only a statistically significant decrease in right-arm muscle values ($p<0.05$).

CONCLUSION: Acquiring a multifaceted approach and a good algorithm in follow-up such as diet and exercise after LSG surgery will ensure that patients lose more weight healthily.

Keywords: Laparoscopic sleeve gastrectomy, bioelectric impedance analysis, obesity

ÖZET

AMAÇ: Obezite bir sağlık sorunudur. Laparoskopik sleeve gastrektomi (LSG) ameliyatı obezite tedavisinde en yaygın kullanılan cerrahi yöntemdir. LSG sonrası takip, ameliyatın kendisi kadar önemlidir. Bu çalışma, yağ ve kas gibi vücut kompozisyonlarındaki değişiklikleri inceleyerek LSG'nin postoperatif takibinde izlenmenin en doğru yolunu incelemeyi amaçlamaktadır.

GEREÇ VE YÖNTEM: Eylül 2019-Mart 2020 tarihleri arasında Kırşehir Eğitim ve Araştırma Hastanesinde tek cerrah tarafından LSG ameliyatı geçiren 19 kadın hasta çalışmaya dahil edildi. Hastaların ortalama yaşı 35,73 yıldı. Ortalama vücut kitle indeksi (VKİ) 43.03 idi. Hastalara ameliyat öncesi, ameliyat sonrası 1. ve 2. aylarda biyoelektrik empedans analizi yapıldı. Sonuçların istatistiksel değerlendirmesi yapıldı.

BULGULAR: Kilo, VKİ ve yağ gibi birçok istenmeyen değer önemli ölçüde azaldı ($p<0.05$). Ancak mineral, protein ve sıvı değerlerinde özellikle 2. ay ölçümlerinde anlamlı değerler elde edilmedi (sırasıyla $p = 0,582$, $p = 0,160$, $p = 0,376$). Ekstremite kası değerlerine bakıldığında sağ ve sol bacak ve sol kol kaslarında 2. ay ölçümlerinde istatistiksel olarak anlamlı olmayan değerler elde edildi (sırasıyla $p = 0,431$, $p = 0,132$, $p = 0,413$). Sağ kol kas değerlerinde sadece istatistiksel olarak anlamlı bir düşüş vardı ($p<0.05$).

SONUÇ: LSG ameliyatı sonrası diyet ve egzersiz gibi takiplerde çok yönlü bir yaklaşım ve iyi bir algoritma edinilmesi, hastaların daha sağlıklı kilo vermesini sağlayacaktır.

Anahtar Kelimeler: Laparoskopik sleeve gastrektomi, biyoelektirik impedans analizi, obezite

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INTRODUCTION

Obesity is a health problem associated with accompanying diseases, morbidity and mortality. We can say that obesity is a social problem caused by inactivity and unhealthy nutrition in our current life. Many innovations such as today's technology, advanced computer systems and unmanned production have caused people to move less compared to before and led to obesity. Obese people have more economic burden on health systems (1).

Diet, exercise, and medical treatments can be tried to ensure the weight loss of obese people. Surgery can be performed if these treatment methods are not beneficial. LSG is the most commonly used method in today's technology and among the surgical procedures accepted in medicine. In the surgery, it is aimed to resect 2/3 of the stomach with a vertical incision starting from 4-5 cm to the pylorus on the greater curvature side and extending upwards and ending at the angle of His. It is also known as tube stomach surgery since the remaining stomach is in the form of a tube. A person who has undergone LSG surgery can lose 20% of their total body weight within 1 year (2).

Bioelectrical impedance method (BIA) is a cheap, easy to apply, non-invasive, safe, and reproducible method. Body fat (FM, % and kg), lean mass (FFM, % and kg), muscle amount (MM, % and kg), total body fluid (TBW % and lt), extracellular fluid (ECW, % and lt), intracellular fluid (ICW % and lt), fat index (FMI, kg/m2), and lean mass index (FFMI, kg/m2) can be measured with this method. FMI and FFMI are obtained by dividing the fat or non-fat mass by the square of the person's height, similar to the body mass index (BMI), thus these indexes allow a more detailed evaluation of the fat and non-fat mass (3).

Systemic morbid diseases such as hyperlipidemia, high cholesterol and hypertension are known to be associated with body fat ratio. Body fat and muscle ratios are parameters frequently followed by dieticians in particular. It is important to know how much and from which body composition the weight loss is. Even though there are many forms of follow-up for this, BIA measurements are the most commonly used (3). Beside being easy, better results can be obtained with the effective parameters BIA provides during its application. In our study, we followed up the well-being related to weight loss with BIA measurements.

MATERIAL AND METHOD

The approval for the study was obtained from the Local Ethics Committee of Ahi Evran University, Faculty of Medicine on March 23, 2021, with the number of 2021-06/54. The work has been completed in accordance with the Helsinki Declaration of Human Rights. 19 female patients who underwent LSG surgery by a single surgeon in Kırşehir Training and Research Hospital between September 2019 and March 2020 were included in our study. The mean age of the patients was 35.73 years. The mean BMI was 43.03. All surgical preparation stages of the patients were performed in the same way. Departments of cardiology, pulmonary diseases, psychiatry, endocrinology, and anesthesia/reanimation were consulted. Health committee reports and surgery requirements were arranged as stipulated by the Ministry of Health. Postoperative follow-up of the patients was performed in a regular manner. Patients who did not come to the desired follow-up examinations, did not comply with the recommended diet or had deficiencies in their documents were excluded from the study. Male patients were excluded from the study considering their weight loss and lifestyle compared to female patients and considering that it may affect statistical values. A standard diet was followed by the patients during their postoperative follow-up. After the first 15 days of fluid intake, purée and solid food intake were started. Vitamin supplementation was provided to all of our patients with multivitamin preparations. Walking for a month was recommended to our patients after surgery. Afterward, light exercises were started. BIA measurements of the patients were taken before surgery, at the 1st month, and at the 2nd month after surgery. BIA measurement was always performed by the same study team members. Patients were always weighed using a calibrated scale (TANITA) at the same time in the morning, standing, with an empty bladder, and wearing light underwear. None of the patients had a job that required muscle strength. They all lived a standard life and followed their treatment recommendations exactly. Measurements were made and living conditions were questioned when they came to regular follow-up checks. How well they adhered to dietary recommendations was confirmed.

Statistical Analysis

Statistical analysis of the study was performed using Statistical Package for Social Sciences version 21.0 software for Windows (IBM SPSS Statistics for Windows, Version 21.0. Armonk, NY: IBM Corp., USA). Normality assumption was tested using Kolmogorov-Smirnov and Shapiro-Wilk tests. Descriptive statistics of the variables were given as mean∓standard deviation. Differences between the observations measured at 3 different times from the same patients were tested with paired sample t-test. Cases with p-values below 0.05 were interpreted as statistically significant in all statistical analyses.

RESULTS

BIA measurements were made before the surgery, at the postoperative 1st and 2nd months. Weight, BMI, lean mass, fat, mineral, protein, fluid (extracellular and intracellular fluid), degree of obesity, body density, internal fat, skeletal muscles, organ muscles, basal metabolic rate and fat/muscle ratios of the extremities were measured. Descriptive statistics and group comparisons of the measurements are provided in **Table 1.** Extremely significant and positive results were obtained when comparing preoperative and postoperative measurements according to **Table 1.** when the values were examined more closely, It was observed

that while undesirable values such as weight, BMI, and fat decreased significantly ($p<0.05$), no significant values were obtained in mineral, protein, and liquid values, especially in the 2nd month measurements ($p=0.582$, $p=0.160$, $p=0.376$, respectively). When extremity muscle values were examined, statistically insignificant values were obtained in the 2nd month measurements in the right and left leg and left arm muscles ($p=0.431$, $p=0.132$, $p=0.413$, respectively). There was a statistically significant decrease only in right-arm muscle values ($p<0.05$).

DISCUSSION

Obesity is generally the increase in the ratio of body fat mass to lean body mass, resulting in the bodyweight exceeding the desired level for height. Obesity and its accompanying diseases carry a very serious risk of morbidity and mortality. Obesity is estimated to be 20% by 2025 according to the World Health Organization (WHO) (4). Obesity causes 2.8 million deaths every year according to the WHO. Similarly, 35.8 million people experience restrictions in their lives due to obesity (5). Obesity is accompanied by life-threatening diseases. It can disrupt almost all body systems. Many diseases such as hypertension, hyperlipidemia, diabetes mellitus, cardiac pathologies, acute myocardial infarction, different organ malignancies, or polycystic ovary pathologies can be listed. In addition, one's lack of self-confidence, loss of social environment, and deterioration in the comfort of life due to excessive weight are among the obvious pathologies. Body mass index (BMI) is an adult's weight divided by the square of their height. BMI of a healthy individual is required to be between 21-23 (6).

LSG is the most commonly performed type of bariatric surgery in the world. In fact, this method, known as a step of the biliopancreatic diversion surgical method, has proved its success in losing weight alone over time and has become the most preferred method today (7). Appropriate patient selection is very important for bariatric surgery. Patients should be referred for diet, exercise, and medical treatments before surgery.

If the desired weight loss has not been achieved and the patient has a BMI above 35 and has additional diseases

Table 1. Descriptive statistics for variables

Variables		preoperative	Postoperative 1st month	Postoperative 2nd month	Preop - 1st month	Preop - 2nd month	1st month-2nd month
Weight		109.2∓12.9	98.6∓12.7	92.4∓12.7	0.000	0.000	0.000
BMI		43.0∓4.7	38.8∓4.7	36.4∓4.8	0.000	0.000	0.000
Fat-free mass		61.5∓5.4	56.3∓5.6	53.0∓6.1	0.000	0.000	0.000
Fat		47.3∓9.5	41.8∓9.3	37.6∓8.5	0.000	0.000	0.000
Mineral		4.2∓0.6	4.0∓0.5	4.0∓0.5	0.000	0.003	0.582
Protein		13.3∓1.0	12.5∓1.3	12.3∓1.2	0.000	0.000	0.160
Fluid		44.4∓3.0	42.0∓3.9	41.6∓3.3	0.000	0.000	0.376
Intracellular fluid		23.8∓1.6	22.5∓1.7	21.9∓1.8	0.000	0.000	0.002
Extracellular fluid		20.5∓1.8	19.1∓2.0	18.7∓2.0	0.000	0.000	0.012
Obesity degree		85.6∓20.5	70.5∓19.2	60.9∓18.5	0.000	0.000	0.000
Body density		1.0001∓0.008	1.0053∓0.007	1.0083∓0.007	0.000	0.000	0.000
Steatosis		12.0∓3.3	10.5∓2.7	9.3∓2.3	0.000	0.000	0.000
Skeletal muscles		35.1∓2.6	32.9∓3.1	31.6∓3.3	0.000	0.000	0.000
Organ muscles		21.4∓1.6	20.0∓1.9	19.5∓1.8	0.000	0.000	0.000
Basal metabolic rate		1.9∓0.1	1.8∓0.1	1.7∓0.1	0.000	0.000	0.000
Right Leg							
	fat rate	50.9∓3.0	48.1∓4.1	47.0∓3.0	0.000	0.000	0.000
	fat	10.3∓1.9	9.0∓2.0	8.2∓2.0	0.000	0.000	0.000
	fatless	9.8∓0.7	9.5∓0.8	9.0∓0.9	0.000	0.000	0.000
	muscle	9.2∓0.6	9.0∓0.7	8.9∓0.8	0.016	0.000	0.431
Left leg							
	fat rate	50.6∓3.0	48.3∓3.4	47.0∓3.7	0.000	0.000	0.000
	fat	10.2∓2.0	9.0∓2.1	8.2∓2.0	0.000	0.000	0.000
	fatless	9.8∓0.7	9.3∓0.8	8.9∓0.9	0.000	0.000	0.000
	muscle	9.2∓0.7	8.8∓0.9	8.6∓1.1	0.000	0.001	0.132
Right arm							
	fat rate	55.1∓4.9	51.5∓4.9	48.1∓5.5	0.000	0.000	0.000
	fat	3.9∓1.0	3.2∓1.0	3.9∓1.0	0.000	0.000	0.000
	fatless	3.0∓0.2	2.7∓0.3	2.6∓0.2	0.000	0.000	0.000
	muscle	2.8∓0.2	2.6∓0.2	2.5∓0.3	0.000	0.000	0.000
Left arm							
	fat rate	56.1∓5.0	52.3∓5.3	49.2∓5.9	0.000	0.000	0.000
	fat	4.3∓1.2	3.5∓1.2	3.1∓1.2	0.000	0.000	0.000
	fatless	3.2∓0.2	2.9∓0.3	2.7∓0.3	0.000	0.000	0.000
	muscle	3.0∓0.2	2.8∓0.2	2.7∓0.3	0.000	0.000	0.413
Body							
	fat rate	33.5∓5.1	32.0∓4.5	30.4∓4.3	0.155	0.000	0.092
	fat	18.4∓4.1	17.0∓3.4	15.7∓3.6	0.000	0.000	0.000
	fatless	35.8∓3.2	33.6∓2.8	32.7∓2.7	0.000	0.000	0.005
	muscle	34.2∓3.1	32.1∓2.8	31.4∓2.6	0.000	0.000	0.024

(at least 1 health condition related to obesity such as type 2 diabetes, obstructive sleep apnea, high blood pressure, arthritis or high cholesterol), this surgery can be performed. A patient is also a candidate for this surgical procedure if he/she has a BMI of 40 and above and doesn't have additional diseases. In LSG, a 2/3 resection of the stomach is made by making a vertical incision from the esophagocardiac junction to the distal antrum (8). This surgery does not only reduce the volume of the stomach, it has also been associated with rapid gastric emptying, accelerated gastrointestinal passage, increased GLP-1 hormone and decreased secretion of the ghrelin hormone (8-10).

A diet should be administered to patients during follow-up after LSG. Oral intake of the patient will be difficult and it is important to accurately determine the initial diet of a resected stomach. Purée and solid foods are generally recommended to the patients in an algorithm after the first 15 days of fluid intake. In this way, the patient's lack of food intake in weight loss is prevented and also a new life is established without stomach strain and expansion (11,12). We used the Mediterranean diet in our clinic. The Mediterranean diet is basically a diet that contains fruits, vegetables, and grains. The diet pyramid also contains meat, fish, milk, and dairy product. CIISCAM (Interuniversity International Center for Mediterranean Food Cultures Studies), meeting in Italy, reached a consensus on the Mediterranean diet (13,14). We asked our patients to put a grain product in their diet every day during the transition to purée and solid food phase after fluid intake. Apart from that, how to preferably consume fish, meat, milk, and dairy products in their diets was described. Carbohydrate-rich foods were more minimized. In addition, coffee consumption was subject to some rules. Patients were asked not to smoke or consume alcohol. Additionally, multivitamin preparation was supplemented.

Exercise planning can be made after LSG. It was found in a study that those who exercised had a decrease in BMI of more than 4% compared to those who did not (15). We advised our patients to walk or the first month. For the second month, extremity and waist movements followed by exercising arm and leg muscles with light weight were recommended. Weekly exercise hours, how many days they exercised for at least 60 minutes, and how many days they exercised heavily for at least 20 minutes were questioned as stated in the Youth Risk Behavior Surveillance System (16) scale when the patients came to the follow-up. The patients were kept in an equal level of exercise program.

The bioelectrical Impedance Analysis method is an analysis method based on the difference in electrical permeability of fat-free tissue mass and fat. The electric current of the BIA device is an 800mA current with a frequency of 50kHz. It has two electrodes called the source and the detector. The electric current flows between two electrodes through conductive materials in the body. Electric current mainly passes through materials with high conduction capacity. The body components that physically carry the current are ions such as sodium and potassium. There is high resistance in parts of the body such as the forearm. Resistance is lower in large parts of the body, such as the torso. Body fat percentage (%), fat weight, fat-free tissue ratio and weight, fluid level as % of total body weight, total body water amount, basal metabolic rate (estimated), average energy requirement (estimated), body mass index, body resistance to current flow (impedance) can be determined with the BIA device (17-19).

BIA measurement is used for follow-up purposes in weight loss. According to the results obtained from BIA, dieticians regulate the protein, fat, and carbohydrate balance and direct the patient by planning exercise if necessary. In our study, we organized a diet program for patients who underwent LSG surgery without any digestive problems. We benefited from the Mediterranean diet, which had previously proven its effectiveness when making the adjustment. We offered this diet to patients in accordance with gastric surgery. We planned an exercise program that was not very complex and we equalized daily and weekly exercise levels and questioned patients using the Youth Risk Behavior Surveillance System scale at the same time. In this way, we provided the patients with equal conditions in terms of surgery, exercise and diet. We aimed to make changes for better results by examining the results obtained in a certain algorithm. We thought that we could achieve the healthiest weight loss after LSG surgery in this way.

We obtained very effective values when we examined the results of our study. We obtained very significant results in undesired fat mass, BMI, and weight values ($p<0.05$). Significant changes in mineral, protein, and fluid values were observed in the 1stmonth measurements ($p<0.05$), and mineral, protein, and fluid values were not maintained at the desired level. Therefore, new dietary adjustments were made for the patients. Mineral supplementation was increased, the amount of protein in the diet was increased and fluid intake was regulated. Significant values were not obtained in the 2ndmonth measurements ($p=0.582$, $p=0.160$, $p=0.376$, respectively) and mineral, protein, and fluid values were maintained. When the muscle values of the extremities were examined, there was a statistically significant decrease in the 1stmonth measurements in the right and left leg and left arm muscles. A mild level of exercise and some muscle mass enhancing weightlifting were requested from the patients. Statistically insignificant values were obtained in the 2ndmonth measurements ($p=0.431$, $p=0.132$, $p=0.413$, respectively). Muscle mass was observed to be preserved. There was a statistically significant decrease in only right-arm muscle values ($p<0.05$).

On literature review, there are studies showing that LSG surgery, besides weight loss, provides significant improvement in terms of morbid systemic diseases such as diabetes mellitus, hypertension, obstructive sleep apnea, and myocardial infarction (20). Cancer research

has been carried out in many areas, including blood groups (21). Obesity is also among the subjects whose relationship with cancer is investigated. Zhou et al. found that the risk of cancer decreased after LSG surgery (22). However, Dizlek et al. who conducted an effective study by scanning the literature in LSG surgeries, found that the main target of LSG was weight loss (23). In our study, in addition to supporting the benefits achieved so far, we argue that psychosocial aspects of patients should be included in postoperative follow-up algorithms and that a follow-up is necessary in all aspects. We think that follow-up should be performed with a multidiscipline approach after LSG surgery. We must remember that patients may feel helpless if we leave them alone after the surgery. It was shown in a study that problems experienced by individuals, feelings of failure and sense of shame would decrease their participation in treatment (24).

CONCLUSION

We do not think it is right to discharge patients by giving only one diet list after LSG surgery. How patients lose weight should be evaluated by being called to follow-ups at regular intervals. The diet and exercise programs of the patients should be under the control of the center where the surgery is performed. Health can be more effectively protected by combining surgery and social life. Treatment algorithms that can be performed after LSG will provide healthier weight loss for patients. Our study is a preliminary study. Further extensive studies are needed.

Study Limitations

Only female patients were included in the study due to changes in body compositions and different living conditions. Among female patients, patients who did not comply with the desired diet and exercise program and who had missing documents were excluded from the study. For these reasons, the number of our cases was not at the desired level.

STATEMENT OF AUTHOR CONTRIBUTIONS

HÖ: work management, article writing, background assessment, literature review, final decision
ZAE: design, article writing, literature review
TU: statistics, literature review

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