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Assessment of energy intake and selected nutrients within 6 months after laparoscopic sleeve gastrectomy

Ocena spożycia energii oraz wybranych składników odżywczych w okresie 6 miesięcy po zabiegu laparoskopowej rękawowej resekcji żołądka

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Keywords

energy supply, protein intake, micronutrients, macronutrients, laparoscopic sleeve gastrectomy

Słowa kluczowe

podaż energii, spożycie białka, mikroskładniki pokarmowe, makroskładniki pokarmowe, laparoskopowa rękawowa resekcja żołądka

Conflict of interest

Konflikt interesów

None

Brak konfliktu interesów

Summary

Introduction. Laparoscopic sleeve gastrectomy is one of the most frequently performed bariatric procedures. It is characterized by high efficiency in reducing excessive body weight, however, it carries a risk of complications, including nutritional deficiencies.

Aim. The aim of the study was to assess energy intake and selected nutrients within 6 months after sleeve gastrectomy.

Material and methods. The study included a group of 48 obese people undergoing laparoscopic cuff gastrectomy. The way of feeding patients before surgery as well as 3 and 6 months after the surgery has been evaluated. The quantitative assessment of daily food rations (dfr) has been conducted using a 24-hour nutritional interview, covering 3 days preceding the study (the assessment did not include supplementation). The energy and nutritional value of menus have been calculated using the computer program Dieta 5. Statistical analysis of the data has been conducted using the Statistica 12 software. To compare the data in individual periods, the t test for independent variables has been used.

The study has been approved by the UMB Bioethics Committee no. R-I-002/525/2010. Each from patients, voluntarily agreed to participate in the study.

Results. After 6 months the energy supply with diet decreased significantly and amounted to 713.15 ± 232.36 kcal/day in the group of women and 972.68 ± 200.48 kcal/day in the group of men. In addition, in both groups there has been a significant reduction in the average consumption of protein, fat, carbohydrates, dietary fiber and vitamins: B₁, C, A, E and folic acid as well as Fe, Mg and Zn, which was insufficient in relation to the demand.

Conclusions. Patients' diet in the early postoperative period is characterized by a very low energy value and is deficient in protein, complex carbohydrates, some minerals and vitamins. Therefore, it seems reasonable to introduce a routine supplementation with a high-protein preparation, a multivitamin preparation, a calcium preparation and vitamin D for each patient undergoing a sleeve gastrectomy, while monitoring the supply of individual nutrients with the diet.

Streszczenie

Wstęp. Laparoskopowa rękawowa resekcja żołądka jest jedną z najczęściej wykonywanych operacji bariatrycznych. Charakteryzuje się dużą efektywnością w redukcji nadmiernej masy ciała, jednak niesie ze sobą ryzyko powikłań, w tym niedoborów pokarmowych.

Cel pracy. Celem pracy była ocena spożycia energii oraz wybranych składników odżywczych w okresie 6 miesięcy po zabiegu rękawowej resekcji żołądka.

Materiał i metody. Badaniem objęto grupę 48 otyłych osób poddanych laparoskopowej mankietowej resekcji żołądka. Ocenie poddano sposób żywienia pacjentów przed zabiegiem operacyjnym oraz 3 i 6 miesięcy po zabiegu. Ocenię ilościową dziennych racji pokarmowych (dzrp) przeprowadzono metodą 24-godzinnego wywiadu żywieniowego, obejmującego 3 dni poprzedzające badanie (ocena nie obejmowała suplementacji). Wartość energetyczną i odżywczą jadłospisów wyliczono za pomocą programu komputerowego Dieta 5. Analizę statystyczną danych przeprowadzono z zastosowaniem programu

Statistica 12. Do porównania danych w poszczególnych okresach wykorzystano test t dla zmiennych niezależnych.

Badanie uzyskało zgodę Komisji Bioetycznej UMB nr R-I-002/525/2010. Każdy pacjent wyraził dobrowolną zgodę na udział w badaniu.

Wyniki. Po 6 miesiącach podaż energii z diety uległa istotnemu obniżeniu i wynosiła $713,15 \pm 232,36$ kcal/dobę w grupie kobiet i $972,68 \pm 200,48$ kcal/dobę w grupie mężczyzn. Ponadto w obu grupach odnotowano istotne obniżenie średniego spożycia białka, tłuszczu, węglowodanów, błonnika pokarmowego oraz witamin: B₁, C, A, E i kwasu foliowego oraz Fe, Mg i Zn, które było niewystarczające w stosunku do zapotrzebowania.

Wnioski. Dieta pacjentów we wczesnym okresie pooperacyjnym charakteryzuje się bardzo niską wartością energetyczną oraz jest niedoborowa w białko, węglowodany złożone, niektóre składniki mineralne oraz witaminy. Zasadnym wydaje się więc wprowadzenie rutynowej suplementacji preparatem wysokobiałkowym, preparatem multiwitaminowym, preparatem wapnia oraz witaminy D w przypadku każdego pacjenta poddanego rękawowej resekcji żołądka, przy jednoczesnym monitorowaniu podaży poszczególnych składników odżywczych z diety.

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INTRODUCTION

Laparoscopic sleeve gastrectomy is one of the most frequently performed bariatric procedures. It is characterized by high efficiency in reducing excessive body weight, however, it carries a risk of complications, including nutritional deficiencies (1, 2). LSG reduces the volume of the stomach, which prevents the patient from consuming large amounts of food. Consuming very small portions of food contributes to an insufficient supply of energy and nutrients in relation to the body's needs, which leads to the development of nutritional deficiencies.

AIM

The aim of the study was to assess energy intake and selected nutrients in the period of 6 months after sleeve gastrectomy.

MATERIAL AND METHODS

The study included a group of 48 obese people (32 women and 16 men) undergoing surgical treatment of obesity (laparoscopic sleeve gastrectomy). The inclusion criteria were age (18-64 years), BMI (≥ 40 or ≥ 35 kg/m²) and two co-morbidities of obesity. The study excluded patients with tumors of the gastrointestinal tract, severe circulatory and respiratory failure and pregnant women.

The way of feeding patients before surgery as well as 3 and 6 months after was evaluated. The quantitative assessment of daily food rations (dfr) in each of the evaluated periods has been conducted using the

24-hour nutritional interview, covering 3 days preceding the study (the assessment did not include supplementation). The energy and nutritional value of menus has been calculated using the computer program Dieta 5 developed by the Institute of Food and Nutrition (IŻŻ) in Warsaw. At the initial visit and at control visits, measurements of height and weight have been made. The BMI index has been calculated for each patient.

Statistical analysis of data (mean values, standard deviation, minimum and maximum values) has been conducted using the Statistica 12 software. To compare data in particular periods, the t test for independent variables has been used. Statistically significant results were those where $p \leq 0.05$.

The study has been approved by the UMB Bioethics Committee no. R-I-002/525/2010. Each from patients, voluntarily agreed to participate in the study.

RESULTS

Before the surgery, the average body mass and average BMI in the group of women have been respectively 117.26 ± 21.54 kg and 44.55 ± 9.55 kg/m² and in the group of men 137.25 ± 27.19 kg and 45.58 ± 10.19 kg/m². Both, 3 and 6 months after surgery, both groups experienced a significant reduction. The results are presented in tables 1 and 2.

The assessment of the method of nutrition shows that before the surgical treatment the energy value of daily obese diets varied. In the group of women,

Tab. 1. Anthropometric measurements of women prior to the surgery, 3 and 6 months after the surgery

	Prior to surgery	3 months after surgery	6 months after surgery
	Mean \pm SD (range)	Mean \pm SD (range)	Mean \pm SD (range)
Age (years)		39.43 \pm 8.73 (25.00-57.00)	
Height (cm)		164.56 \pm 6.82 (153.00-175.00)	
Body weight (kg)	117.26 \pm 21.54 (82.00-169.90)	98.67 \pm 21.20* (65.50-148.60)	91.90 \pm 19.03* (59.00-141.50)
BMI (kg/m ²)	44.55 \pm 9.55 (32.8-72.6)	36.65 \pm 9.12* (26.2-63.47)	34.0 \pm 8.96* (23.63-60.4)

*statistical significance $p < 0.05$ in comparison to initial values (before the surgery)

Tab. 2. Anthropometric measurements of men prior to the surgery, 3 and 6 months after the surgery

	Prior to surgery	3 months after surgery	6 months after surgery
	Mean \pm SD (range)	Mean \pm SD (range)	Mean \pm SD (range)
Age (years)		47.12 \pm 9.95 (29.00-62.00)	
Height (cm)		174.87 \pm 5.32 (164.00-182.00)	
Body weight (kg)	137.25 \pm 27.19 (101.00-175.00)	116.97 \pm 21.18* (88.00-152.20)	111.43 \pm 26.16* (81.50-156.10)
BMI (kg/m ²)	45.58 \pm 10.19 (32.6-60.5)	38.31 \pm 7.25* (31.8-52.6)	36.69 \pm 9.04* (28.7-53.97)

*statistical significance $p < 0.05$ in comparison to initial values (before the surgery)

it ranged between 777.27 and 4090.29 kcal (on average, 2002.64 \pm 1106.98 kcal). After 3 months from the procedure, the average energy value of the daily food ration decreased to 543.35 \pm 217.94 kcal, and after 6 months it was on average 713.15 \pm 232.3 kcal/day. In the group of men, the daily food intake prior to the surgery provided on average 2473.64 \pm 1090.75 kcal/day, 3 months after the surgery 665.07 \pm 175.98 kcal/day, and after 6 months 972.68 \pm 200.48 kcal/day. In both groups the differences were statistically significant. The study also evaluated the intake of protein in various postoperative periods. It was shown that in both groups, the supply of protein 3 and 6 months after the surgery was significantly reduced in relation to the supply of this component in the pre-operative period. In addition, in the group of men, a statistically significant increase in protein intake was found after 6 months from the procedure compared to its consumption 3 months after the procedure. Six months after surgery, both groups revealed a reduction in the average consumption, among others: fat, carbohydrates, dietary fiber and some vitamins (B₁, C, A, E and folic acid) and minerals (Fe, Mg and Zn). Comparing the average consumption of individual nutrients 3 and 6 months after the procedure, it has been proved that in the group of women the supply of energy, cholesterol, dietary fiber, vitamin B₁, magnesium, potassium and zinc increased significantly. In the group of men there has been an average increase in the energy value and consumption of protein, fat, carbohydrates, dietary fiber, some vitamins (B₁, B₁₂, A), calcium and zinc. The average energy and nutritional value of the diet in the periods evaluated are presented in tables 3 and 4.

DISCUSSION

The effectiveness of surgical treatment of obesity is to a large extent determined by the change of the current diet, consisting, among other, in lowering the energy value of the diet and ensuring optimal protein supply. In the present study, the average energy value of menus of examined women, 3 and 6 months after the procedure has been respectively 533.35 \pm 217.94 kcal and 713.15 \pm 232.3 kcal/day. In the group of men, the daily food ration delivered on average 665.07 \pm 175.98 kcal/day and 972.68 \pm 200.48 kcal/day, re-

spectively. Similar results have been obtained by Belfiore et al. (3). In turn, Degan et al. (4) indicated that the daily food rations 3 and 6 months after the surgery were characterized by a higher energy value than in our study. In the group of women, they provided 740.1 \pm 271.9 kcal and 981.8 \pm 316.2 kcal respectively, and in the group of men they were respectively 979.2 \pm 398.5 kcal and 1280 \pm 555.8 kcal. Similar results have been obtained by Abu Jadayil et al. (5). The presented data reveal that the energy supply during the first 6 months after bariatric surgery is insufficient in relation to the energy needs of the organism, which contributes to the reduction of resting energy expenditure (REE). According to the guidelines, the minimum protein intake after bariatric procedures should be 60 g/day (6). In practice, it is very difficult to achieve the recommended supply of this ingredient, especially during the first 6 months after surgery. Low protein intake is primarily due to the limited possibility of consuming large portions of food, poor tolerance of protein products, limited digestion and absorption of nutrients. In our study, the supply of protein in each of the evaluated periods was insufficient. Only in the group of men, 6 months after the procedure, the average protein intake reached the value above 60 g/day. Available data indicate that 3 months after the sleeve gastrectomy, the recommended protein intake has not been achieved by over 80% of patients, and after 6 months 67% of subjects (4, 7). Average protein supply 3 months after SG is at 28.28 \pm 3.06 g to 49.8 \pm 22.0 g/day, and 6 months after SG from 38.96 \pm 3.08 to 57.8 \pm 20.5 g/day (4, 5, 8, 9). The review of the literature shows that patients consuming protein in the amount below 60 g per day revealed significant loss of lean body mass (10-14). Loss of lean body mass (including muscle mass) contributes to the reduction of REE. It has been shown that REE significantly decreases after the sleeve gastrectomy and the degree of metabolic adaptation of the body increases significantly. There are indications that a higher degree of metabolic adaptation may result in less weight loss after the surgery (15). According to recommendations, the minimum demand for children and adults for carbohydrates is 130 grams. This is the amount necessary for the proper functioning of the brain (16, 17). In addition, it has been shown that consumption of 100 g

Tab. 3. Energy and nutritional value of daily food rations of women prior to the surgery, 3 and 6 months after the surgery

	Prior to surgery	RDA	6 months after surgery	
	Mean \pm SD (range)		Mean \pm SD (range)	Mean \pm SD (range)
Energy (kcal)	2002.64 \pm 1106.98 (767.27-4090.29)	–	543.35 \pm 217.94* (187.62-976.42)	713.15 \pm 232.36*† (238.42-1152.78)
Protein (g)	80.991 \pm 38.60 (41.20-155.43)	\geq 60	43.30 \pm 16.23* (23.27-78.49)	46.28 \pm 13.03* (28.47-67.84)
Protein (%EI)	18.628 \pm 4.26 (12.35-28.18)	–	34.66 \pm 11.35* (19.03-53.23)	26.29 \pm 6.76*† (17.24-41.62)
Fat (g)	79.852 \pm 55.00 (27.74-92.20)	–	19.15 \pm 8.73* (6.06-33.10)	23.08 \pm 5.61* (13.95-39.41)
Fat (%EI)	37.24 \pm 7.66 (21.42-48.91)	–	30.91 \pm 7.21* (21.25-43.73)	29.30 \pm 7.69* (15.42-39.13)
Cholesterol (mg)	275.47 \pm 190.50 (118.18-869.40)	\leq 200	104.69 \pm 42.35* (16.90-156.12)	117.21 \pm 59.15*† (63.38-307.45)
Carbohydrates (g)	209.01 \pm 109.79 (78.6-489.6)	100-130	53.56 \pm 30.94* (9.89-109.85)	86.93 \pm 43.90* (31.48-191.66)
Carbohydrates (%EI)	41.87 \pm 8.37 (21.42-55.41)		34.37 \pm 11.44* (19.08-52.03)	42.67 \pm 11.96 (19.37-65.44)
Fiber(g)	16.55 \pm 6.17 (5.17-24.72)	20	4.88 \pm 2.44* (0.52-8.34)	7.98 \pm 3.37*† (2.03-15.01)
Vit. B ₁ (mg)	1.26 \pm 0.82 (0.56-4.04)	1.1	0.36 \pm 0.15* (0.11-0.58)	0.57 \pm 0.23*† (0.28-1.18)
Vit. B ₁₂ (μ g)	3.05 \pm 1.656 (1.03-6.18)	2.4	3.42 \pm 3.51 (0.50-11.89)	2.02 \pm 0.96 (0.80-3.75)
Folate (μ g)	248.17 \pm 82.11 (114.12-451.21)	450	103.54 \pm 43.07* (48.36-213.78)	118.97 \pm 44.93* (17.35-221.45)
Vit. C (mg)	100.37 \pm 50.40 (8.05-215.68)	75	32.64 \pm 19.72* (2.27-64.90)	50.90 \pm 35.63* (10.30-124.65)
Vit. E (mg)	10.30 \pm 6.04 (2.80-21.38)	8	2.24 \pm 1.00* (0.60-3.95)	3.44 \pm 2.39* (1.72-10.09)
Vit. A (μ g)	814.42 \pm 391.70 (128.57-1413.02)	700	488.61 \pm 507.13* (93.58-2287.60)	545.55 \pm 535.85 (174.20-2382.34)
Vit. D (μ g)	2.60 \pm 1.65 (0.59-5.69)	15	2.02 \pm 3.14 (0.10-9.17)	1.35 \pm 1.81 (0.19-7.89)
Ca (mg)	772.04 \pm 576.69 (227.83-1959.92)	1000	447.35 \pm 284.07* (74.14-952.38)	443.09 \pm 232.73 (193.30-926.09)
Fe (mg)	9.88 \pm 3.43 (5.26-16.08)	18	3.57 \pm 2.61* (0.84-12.84)	4.76 \pm 1.34* (1.35-6.48)
Mg (mg)	284.25 \pm 95.45 (167.22-444.66)	320	118.08 \pm 60.35* (38.55-302.93)	168.50 \pm 48.35*† (99.70-259.30)
Zn (mg)	9.97 \pm 3.97 (4.73-16.92)	8	3.52 \pm 1.26* (1.21-6.13)	4.54 \pm 1.36*† (3.01-7.51)

EI – energy intake; RDA – Recommended Dietary Allowance

*statistical significance $p < 0.05$ in comparison to initial values (before the surgery)†statistical significance $p < 0.05$ in comparison to values 3 months after surgery

of carbohydrates during the day reduces the nitrogen loss by 40%, and therefore reduces the loss of muscle tissue (17). In our study, only a group of men 6 months after the procedure showed a carbohydrate intake exceeding 100 g/day. In most of the works of other authors, within 3 months after the sleeve gastrectomy, the supply of carbohydrates was also insufficient. In turn, after 6 months, the average amount of carbohydrates in daily food rations was at the level of 111 ± 8 g/day to 114 ± 30.3 g/day (3, 4, 7, 8, 18-20).

The diet of patients after bariatric surgery should contain less fat. The average daily fat intake 3 months after sleeve gastrectomy is varied and ranges from 24.96 ± 3.17 to 47.0 ± 4.0 grams, and after 6 months

it 40.3 ± 15.5 to 58 ± 6 grams (3-5, 7-9, 18-20). In our study, the average amount of fat in the diet was lower than in the majority of studies reviewed. Undoubtedly, a diet that supplies insufficient amount fat is deficient in vitamins A, E and D, which we have shown in our study. This is also confirmed by the results of the work of other authors (21, 22). In the present study we have also demonstrated insufficient supply of B₁ vitamins, vitamin C, folic acid, iron, calcium, magnesium and zinc. Abu Jadayil et al. (5) reports that the diet of patients undergoing SG both, 3 and 6 months after the surgery was deficient in Ca, Fe, Zn, folic acid. Deficiencies in calcium and iron in the diet are confirmed by the results of Moize et al. (19). The deficiency of vitamin B₁ in

Tab. 4. Energy and nutritional value of daily food rations of men prior to the surgery, 3 and 6 months after the surgery

	Prior to surgery	RDA	3 months after surgery	6 months after surgery
	Mean \pm SD (range)		Mean \pm SD (range)	Mean \pm SD (range)
Energy (kcal)	2473.64 \pm 1090.75 (1325.75-4982.06)	–	665.07 \pm 175.98* (477.31-1056.28)	972.68 \pm 200.48*† (721.15-1226.53)
Protein (g)	120.35 \pm 48.39 (78.23-234.71)	\geq 60	46.96 \pm 15.49* (24.38-68.20)	63.32 \pm 17.54*† (32.16-78.15)
Protein (%EI)	21.40 \pm 9.28 (13.85-44.52)	–	32.30 \pm 9.05* (22.5-51.68)	27.65 \pm 8.90 (15.68-43.19)
Fat (g)	123.65 \pm 77.16 (32.13-254.72)	–	15.84 \pm 5.11* (8.35-22.34)	27.77 \pm 7.71*† (18.39-37.15)
Fat (%EI)	34.84 \pm 7.79 (21.67-48.48)	–	23.47 \pm 4.11* (16.84-29.89)	25.84 \pm 5.55* (16.97-34.76)
Cholesterol (mg)	399.98 \pm 232.55 (187.39-957.81)	\leq 200	170.01 \pm 93.98* (56.88-314.61)	200.71 \pm 69.30* (106.89-322.17)
Carbohydrates (g)	283.24 \pm 116.95 (123.19-547.48)	100-130	65.56 \pm 15.12* (39.72-79.38)	123.37 \pm 36.88*† (68.61-169.04)
Carbohydrates (%EI)	43.75 \pm 6.15 (33.82-50.83)	–	43.46 \pm 5.92 (31.47-47.59)	46.30 \pm 6.34 (33.37-50.93)
Fiber(g)	22.37 \pm 7.44 (12.19-33.91)	20	7.52 \pm 2.14* (4.69-11.1)	11.65 \pm 5.97*† (4.89-18.96)
Vit. B1 (mg)	1.92 \pm 0.80 (0.90-3.29)	1.3	0.37 \pm 0.89* (0.27-0.53)	0.75 \pm 0.24*† (0.45-1.18)
Vit. B12 (μ g)	4.13 \pm 1.55 (1.82-6.8)	2.4	2.36 \pm 0.77* (1.47-4.19)	4.08 \pm 2.91† (1.47-9.69)
Folate (μ g)	303.38 \pm 153.41 (88.56-582.44)	400	137.95 \pm 46.53* (87.33-212.20)	174.62 \pm 51.45* (72.25-232.40)
Vit. C (mg)	79.78 \pm 34.71 (31.06-148.63)	90	43.27 \pm 13.14* (22.68-60.84)	55.50 \pm 28.36 (14.29-83.23)
Vit. E (mg)	10.65 \pm 9.23 (3.38-32.22)	10	3.16 \pm 2.06* (1.03-7.43)	4.15 \pm 1.21* (2.07-5.31)
Vit. A (μ g)	1106.81 \pm 652.40 (439.58-2528.35)	900	564.54 \pm 229.10* (312.47-849.48)	917.02 \pm 469.68† (324.32-1630.53)
Vit. D (μ g)	4.39 \pm 3.33 (1.20-10.52)	15	1.13 \pm 0.60* (0.13-2.44)	2.73 \pm 3.01† (0.33-7.33)
Ca (mg)	1097.24 \pm 824.20 (312.24-3044.41)	1000	474.75 \pm 90.04* (291.50-623.39)	632.07 \pm 138.41† (483.60-878.24)
Fe (mg)	14.01 \pm 7.09 (7.67-31.21)	10	4.04 \pm 0.97 (2.89-5.46)	7.02 \pm 3.49*† (3.16-13.34)
Mg (mg)	380.58 \pm 121.22 (232.85-649.70)	420	189.48 \pm 55.08* (124.44-302.93)	195.76 \pm 57.65* (96.99-279.25)
Zn (mg)	14.84 \pm 5.25 (9.50-25.40)	11	4.40 \pm 1.32* (3.06-6.64)	6.57 \pm 1.68*† (3.95-8.88)

EI – energy intake; RDA – Recommended Dietary Allowance

*statistical significance $p < 0.05$ in comparison to initial values (before the surgery)

†statistical significance $p < 0.05$ in comparison to values 3 months after surgery

the diet was demonstrated by Moore and Sherman (9) and Basfi-fer et al. (21).

CONCLUSIONS

The diet of patients in the early postoperative period is characterized by a very low energy value and is deficient in protein, complex carbohydrates, some miner-

als (Ca, Fe, Zn, Mg) and vitamins (vitamin B₁, folate, vitamin C, vitamin D). Therefore, it seems reasonable to introduce a routine supplementation with high-protein preparations, a multivitamin preparation, a calcium preparation and vitamin D for each patient undergoing a sleeve gastrectomy, while monitoring the supply of individual nutrients with the diet.

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