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DIETETIC RECOMMENDATIONS AFTER BARIATRIC PROCEDURES IN THE LIGHT OF THE NEW GUIDELINES REGARDING METABOLIC AND BARIATRIC SURGERY

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ABSTRACT

The frequency of obesity occurrence is constantly increasing all over the world and becoming global epidemic. Facing the lack of the efficiency of conservative treatment, patients with II and III degree of obesity are qualified for surgical treatment; however, the efficiency of surgical treatment is connected with permanent change of nutritional habits and previous lifestyle of the patient. Modification of the way of nutrition, regardless of the type of bariatric procedure, should especially include the lowering of food energetic value and change of type, consistency and size of consumed food. Nutritional treatment after bariatric procedures is multistage. It includes clear liquid diet, full liquid diet, pureed diet, mechanically altered soft diet and regular diet. Gradual expanding of the diet protects gastrointestinal tract from chemical, mechanical and thermal irritation by the food. It also should prevent nutritional deficiencies. Significant influence on the result of surgical treatment of obesity has also regular intake of food, consuming products with high nutritional value, avoiding confectionery and fat products, consuming proper amounts of protein (60-80 g/day) and vitamin-mineral supplementation.

Key words: *bariatric surgery, diet/nutrition, morbid obesity*

STRESZCZENIE

Częstość występowania otyłości zwiększa się na całym świecie przyjmując rozmiar globalnej epidemii. Wobec braku skuteczności leczenia zachowawczego, osoby z otyłością II i III stopnia poddawane są leczeniu chirurgicznemu. Warunkiem efektywności leczenia chirurgicznego jest trwała zmiana nawyków żywieniowych i dotychczasowego stylu życia pacjenta. Modyfikacja sposobu żywienia niezależnie od rodzaju zastosowanego zabiegu operacyjnego polega w szczególności na znaczącym obniżeniu wartości energetycznej diety oraz zmianie rodzaju, konsystencji i wielkości spożywanych posiłków. Leczenie żywieniowe po operacjach bariatrycznych jest wieloetapowe. Obejmuje ono: dietę płynną, dietę półpłynną, dietę papkowatą, pokarmy miękkie rozdrobnione oraz zbilansowaną dietę niskoenergetyczną. Stopniowe rozszerzanie diety ma na celu ochronę przewodu pokarmowego przed drażnieniem chemicznym, mechanicznym i termicznym spożywanych pokarmów. Ma jednocześnie zapobiegać niedoborom żywieniowym. Istotny wpływ na skuteczność chirurgicznego leczenia otyłości ma także regularne spożywanie posiłków, spożywanie produktów o wysokiej wartości odżywczej, unikanie słodyczy oraz produktów i potraw tłustych, spożywanie odpowiedniej ilości białka (60-80 g/dobę) oraz stosowanie suplementacji preparatami mineralno-witaminowymi.

Słowa kluczowe: *chirurgia bariatryczna, dieta / żywienie, otyłość olbrzymia*

INTRODUCTION

Prepared in 2012 by WHO report indicates that 50% of adult citizens of European Union has excessive body mass and 17% is obese [19]. In Poland 22% of population is already obese and this rate is constantly increasing [6]. It is estimated that until 2035 every third adult Polish citizen will be obese. In case of patients with morbid obesity (BMI $\geq$40kg/m^2), conservative treatment does not bring effects and that is why they are qualified for surgical treatment. The indication for surgical treatment is also BMI $\geq$ 35 kg/m^2 and co-morbidities such as: diabetes, hypertension, lipid disorders, circulatory heart disease, sleep apnea, arthritis [16,

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29]. Bariatric surgery is highly efficient method of obesity treatment under a condition that patient after the surgery follows dietetic recommendations and is physically active.

The aim of the article was to present actual recommendations regarding the principles of nutrition of patients after bariatric procedures and to highlight the role of dietician in long-term care for obese patients treated surgically.

METHODS OF SURGICAL TREATMENT OF OBESITY

In surgical treatment of obesity, two types of procedures are applied – restrictive and procedures limiting absorption of nutrients. Restrictive procedures include: gastric sleeve resection, vertical-banded gastroplasty (VBG), gastric banding, adjustable gastric banding (AGB), non-adjustable gastric bypass (GBP) proximal and GBP long/limb [17]. Operations limiting absorption of nutrients may be divided into energy absorption limiting operations (Biliopancreatic diversion -BPD) and combined operations, such as: biliopancreatic diversion with duodenal switch (BPDDS) and distal gastric bypass (common limb 100 cm or less) [17]. Restrictive procedures limit the volume of the stomach and narrow the area where food is passed to the intestine which causes intake of smaller portions of food. Malabsorptive procedures are performed in order to limit the absorptive surface of the gastrointestinal tract, shorten the time of food passage and its contact with digestive enzymes. All this leads to decrease of absorption of nutrients with excessive energetic value (carbohydrates and fats).

NUTRITIONAL PREPARATION FOR PATIENTS QUALIFIED FOR SURGICAL TREATMENT OF OBESITY

According to interdisciplinary European guidelines for metabolic and bariatric surgery, decision about performing surgical procedure should be preceded by the assessment of general health state of patient (including the way of nutrition and nutritional status) conducted by multispecialistic team [16, 29]. Depending on the type of planned bariatric procedure patient should also undergo the assessment of bones density, body content and resting energy expenditure which will enable dietician to plan proper diet [16]. Results of own experiment indicate that the way of nutrition of patients qualified for bariatric surgery was not compatible with nutrition recommendations and their diet was insufficient of polyunsaturated fatty acids, folic acid, potassium, vitamin D, calcium, iron and magnesium [21, 22]. Numerous studies proved that patients with morbid obesity frequently reveal latent deficiencies (especially in vitamin D, B_1 and iron) which may increase after the operation [8, 10, 15, 31, 34]. Though, extremely important is nutritional preparation of the patient qualified for bariatric procedure and dietetic care after the operation. First contact of the patient with dietician should be planned at least 3 months before surgical treatment. During this meeting dietician should assess the way of patient's nutrition and explain him/her how it will look like after the surgery. It is important for patient, to follow the rules of balanced, low-energetic diet before the surgery which will lead to loss of body mass, supply all necessary nutrients and complement nutritional deficiencies. During further visits dietician should assess patient's motivation and abilities to follow dietetic recommendations. What is more, during this preoperative period patient should be educated about the principles of expanding and modifying the diet after the surgery.

DIET BROADENING FOR PATIENTS AFTER BARIATRIC PROCEDURES

The review of bibliography shows that regardless of the applied method of surgical treatment of obesity, modification of the nutritional habits includes mainly the lowering of energetic value of consumed food and changing its type, consistency and volume [1, 18, 23, 24, 28].

According to the guidelines established by The American Association of Clinical Endocrinologists, The Obesity Society and American Society for Metabolic & Bariatric Surgery and recommendations of University of Nevada School of Medicine (Table 1) in the first day after the surgery patient should receive intravenous hydration. Calorie-free liquids, without sugar, caffeine and intensively sweetening substances such as water or weak tea are usually added in 1-2 day after the surgery [1, 16, 24, 28]. Those liquids should be consumed with small sips (15-30 mL) in the amount tolerated by the organism. Final liquids intake should be around 1500-1900 mL/day. Drinking with straw is contradiction because it leads to the swallowing of large amounts of air causing the feeling of fullness and discomfort in abdomen [24, 28]. In early postoperative period patients frequently report intolerance of water (gag reflex, metallic taste). It is recommended to substitute it with fruit tea, weak broth, and vegetable juice. It is also possible to add to water lemon juice or calorie-free flavor enhancers.

In the first week after the surgery specialists recommend to substitute the half of calorie-free liquids taken during the day with high-protein liquids (skim milk, acidophilus milk, low-fat soy milk, skim natural yoghurt) with the addition of high protein whey or soy

Table 1. The scheme of nutrition in early postoperative period prepared by University of Nevada School of Medicine [24]

Period after bariatric surgery	Dietetic recommendations in different stages after the surgery
Day 1-2	• only neutral liquids are allowed (without sugar, carbohydrates and caffeine); • liquids should be sipped in the amount tolerated by the organism with gradual increasing of their volume to approx. 1500 mL/day; • drinking with straw should be avoided in order to reduce the amount of swallowed air;
Day 3-7	• continuation of neutral liquids intake in the amount of approx. 1500 – 1900 mL/day (neutral liquids should be the half of daily intake); • introduction of nutritional beverages (low-fat milk, soy milk, low-fat natural yoghurt, mixed soups); • it is acceptable to add powdered whey protein or isolated soy protein to nutritional beverages (no more than 20 g / portion); • introduction of vitamin-mineral supplementation (1 pill twice a day);
Week 2-3	• enlarge the amount of consumed liquids to 1500-1900 mL /day; • nutritional liquids should be substituted with solid, soft, moist, minced, low-fat and high-protein products (eggs, fish, poultry, lean meat, low-fat cottage cheese, boiled bean); • consume 4-6 meals a day (recommended volume of the meal- ¼ cup); • protein should be consumed in the first place in the amount of 60 g/ day;
Week 4-6	• patient should gradually add to diet such products as boiled, soft and/or peeled or pickled fruits (sugar-free); • one soft, solid meal/product should be included in the diet – if it is tolerated; • 4-6 meals should be consumed (recommended volume - ½ cup) with 60-80 g of protein; • in the first place protein should be consumed in the amount of 60-80 g day; • the supply of neutral liquids should be continued in the amount of 1500-1900 mL /day; • liquids should be consumed 30 minutes before or 30-60 minutes after the meal; • meals should be chewed well;
Week 7 and further	• caloric value of the diet should be adapted to height, body mass and age; • meals should be balanced including lean meat, fruits, vegetables and whole-grain products; • raw fruits and vegetables with high content of fiber should be avoided if they are intolerated (celery, corn, artichokes, tomatoes, pineapples, oranges); may be consumed well boiled or grated; • 3 meals and 2 snacks a day should be consumed (volume - 1 cup); • neutral liquids should be consumed in the amount of 1500-1900 mL /day; • liquids should be consumed 30 minutes before or 30-60 minutes after the meal; • products should be well chewed;

protein supplement [24, 28]. Liquid diet is recommended usually for 2 weeks [1, 24, 28]. For further 14 days, blended diet is recommended. During this time patients should consume soft, moist products with low content of fat and high content of protein such as poultry, lean meat, eggs, fish, low-fat cottage cheese, boiled bean. Some researchers highlight the necessity of preparing food in the form of mush, others claim that it is acceptable to consume solid food but in this case slow and careful chewing of every bite is necessary. In the fourth week after the surgery patient may add to the diet such products as boiled, soft vegetables and soft, ripe and peeled fruits but he also should remember to at first consume products containing complete protein. In case of patients after BPD and BPDDS fruits and vegetables should be introduced later – usually six weeks after the surgery [24, 28].

According to the fact that first week after bariatric surgery diet is based mainly on protein products, patients frequently suffer from constipation connected with deficiency of dietary fiber. In such case, dietician may recommend drinking before meals brewed prunes, lactulose in syrup or, in further period (8 weeks after the surgery), wheat bran or dietary fiber with yoghurts, soups with simultaneous hydration of the organism.

6-8 weeks after the surgery pureed diet may be changed for solid diet. Daily menu should contain such products as: lean meat, poultry or fish, vegetables, whole-grain products, fruits in reasonable amounts. Patients after the BPD or BPDDS may include grain products (whole grain crackers, sugar-free corn flakes with milk) no sooner than 12 weeks after the surgery [1, 28]. Some research prove that in the first year after the surgery patients reveal low tolerance for products based on white flour (white bread) rise, pasta, raw vegetables and fruits with fibrous consistency and products with high content of saccharose and fat, that is why they should be eliminated [12, 14, 38] Sutter proved that tolerance to food in patients after gastric banding lowers along with time. However, after gastric bypass the relation is reversed [39]. According to the guidelines of American Association of Clinical Endocrinologists, the Obesity Society, and American Society for Metabolic & Bariatric Surgery patients should avoid bread, pasta and rice until patient is easily consuming 60 g protein per day (in case of patients after BPD or BPDDS 90 g protein) plus fruits and vegetables [28].

PROTEIN DEMAND AFTER BARIATRIC PROCEDURES

Both, in early and in late postoperative period, it is extremely important to provide proper intake of complete protein and optimal hydration (minimum 1500 mL/day). According to experts' current recommendations the amount of protein in diet of patients after bariatric surgery should be 1-1.5 mg per 1 kg of desired body weight which is 60-80 g per day. In case of patients after BPD or BPDDS, demand for protein increases of further 30% and it is 90-120 g/day [16, 20, 24, 28], however, it should be highlighted that there is a lack of clear evidence confirming those facts [28]. *Schinkel* et al. recommend daily intake of protein of 2.1 g per kg of desired body mass (or 0.95 g/kg of current body weight) [37]. According to *Moize* and *Heber*, demand for protein 1.5 g/kg of desired body mass may help to maintain positive nitrogen balance and prevent the loss of lean body mass [20, 32]. What is more, *Heber* et al. highlighted that patients should each day consume 30 g of protein in more than one meal in order to prevent bones and muscles insufficiencies. What is more, protein should be eaten at breakfast to relive the catabolic state of overnight fasting and to regulate appetite and daily food intake [20]. Proper supply of leucine also plays important role according to the fact that it stimulates protein synthesis and inhibits degradation of skeletal muscles proteins [25]. Perfect source of this amino acid is whey, casein, egg white, isolated soy protein.

Results of multiple studies prove that consumption of protein by patients during the first year after the surgery is insufficient in comparison to the demand [3, 30, 32]. Usually, it is caused by intolerance of high-protein products such as red meat (beef, veal), chicken and turkey (except when it is well chopped), eggs and milk [14, 35, 38]. One of the symptoms of protein deficiency is hair loss. In such situation, supplementation is recommended – with high-protein nutrients (isolates of whey protein). What is more, diet should be enriched with zinc sources (milk and dairy products, whole-grain products, pulses) vitamin B_6 (wheat germ, pulses, nuts, yeast) and pantothenic acid (whole-grain products, wheat bran, pulses, yeast). Specialists recommend supplementation with high-protein preparations (especially for patients after malabsorptive and combined bariatric procedures) if protein supply do not exceed 60 g/day [2, 5, 28]. The role of dietician is to estimate the amount of protein consumed every day and adaptation of proper supplementation with high-protein nutrients, individually for each patient.

Own observation indicates that patients have problems with estimation of daily consumption of protein. It seems to be reasonable for dietitian to establish the list of products which may be a good source of this nutrient along with the definition of the volume of portion (in grams and home measures) and the content of protein (in grams) per 1 portion of product. It will enable to easily compose nutritional portions. What is more, dietician should educate patient in the field of products selection and cooking techniques which may minimize the risk of nutritional intolerance (such as emesis, abdominal pain, the feeling of distension, heartburn).

DUMPING SYNDROME

Meals should be consumed regularly, 5-6 times a day, in small portions, without hurry, each for approximately half an hour. Each bite should be properly chewed. It is also important to drink between meals, 30 minutes before or 30-60 minutes after the meal, especially by patients after GBP [24, 28]. It is connected with minimized risk of early hypoglycemia syndrome called dumping syndrome. The most common consequences of this syndrome are emesis, flatulence, diarrhea, dizziness, and palpitations. Dumping syndrome is caused by accelerated gastric emptying of unhydrolysed, hyperosmolar ingest which, while moving directly into intestinal lumen, causes binding of huge amount of water from the circulatory system in order to equalize osmotic pressure [12, 24]. Gastrointestinal and circulatory system disorders occur also in patients consuming extensive portions of food and those consuming monosaccharides (sweetened beverages, sweets, extensive amounts of fruits, etc.) [24]. Flatulence and diarrhea may be a result of milk consumption by patients with lactose intolerance.

ENERGY AND BASIC NUTRIENTS DEMAND IN LATE POSTOPERATIVE PERIOD

Efficient treatment of obesity after surgical procedure depends mainly on limiting the demand for calories. It is important for dietician to cooperate with patient, estimate his individual energetic demand considering his daily physical activity and estimate proper supply for protein. Estimating individual energetic demand let patient to maintain negative energetic balance which is necessary to lose weight.

In long-term dietetic treatment target energetic value of the diet should be individually adjusted to the age, height and ideal body mass of patient. Review of literature revealed that during the first year after the surgery energetic value of patients' diets is 700-900 kcal per day [11, 32]. 12-36 months after the surgery it is between 1000 and 1400 kcal [4, 32, 33]. Protein

consumption should be 1.0-2.1 g per 1 kg of due body weight which is approximately 25% of caloric value of the diet [1, 32, 37]. The proportion of fats in diet's energetic value should not be higher than 30% [23, 32, 33]. Besides the amount of fat in diet, its quality is also important. Especially recommended are fish fat and olive oil [33]. Energetic value of the diet should be complemented with carbohydrates (approximately 45%) derived from vegetables, fruits and whole-grain products such as rolled oats, fine grits, dark bread. They are great source of fiber, vitamins and minerals. The amount of carbohydrates in daily portion of food should not be lower than 100g which enables total burning of fatty acids and protects systemic protein against its utilization as an energetic material [7]. It was also proved that 100 g of carbohydrates in diet lowers of 40% the loss of nitrogen [1].

FOOD PYRAMID FOR PATIENTS AFTER BARIATRIC PROCEDURES

It seems that the most accessible and understandable form of nutritional recommendations presentation is food guide pyramid. It shows patients which products and in what amounts should be chosen in order to compose balanced and low-energetic meals. *Moize* et al. prepared for patients after gastric bypass "bariatric food pyramid" [33]. At the bottom of the pyramid there are: daily mineral-vitamin supplementation, proper amount of liquids and daily physical activity. The first level of the pyramid includes high-protein and low-fat products. *Moize* et al. recommend daily intake of 4-6 high-protein meals where 1 portion is: 60 g of lean meat (beef, pork or poultry), 60 g of oily sea fish or 80 g of lean fish (white fish), 80 g of lean curd, 140 g of milk, 115 g of yoghurt, 50 g of eggs, 80 g of boiled bean or lentil. It also has to be mentioned that oily fish should be consumed at least 3 times a week. On the second level of the pyramid authors put low-energetic food with high content of fiber (vegetables, fruits) and vegetable oils. They recommend daily intake of 2-3 portions of fruits and 2-3 portions of vegetables (all kinds of vegetables in the amount of 85 g). Due to the fact that fruits' energetic value is different, they were divided into two groups – with low content of carbohydrates (1 portion is 140 g of melon, watermelon, strawberries, grapefruit, apples or oranges) and with high content of carbohydrates (1 portion is 70 g of grapes, apricot, bananas, cherries, nectarines or lychees). According to the fact that vegetable oils provide significant amount of energy, they should be consumed in the amount of 2-3 teaspoons a day. Third level of the pyramid includes 2 portions of starch products (1 portion of starch products is 90 g of boiled rice or pasta, 30 g of whole-grain bread or cereal products, 80 g of boiled pulses or 85 g of boiled potatoes). Fourth and last level of the pyramid includes high-energetic products, containing saturated fats, cholesterol and sweets which should be avoided by patients [33].

NUTRIENTS DEFICIENCIES AND DIET SUPPLEMENTATION

Bariatric procedures are strictly connected with the risk of deficiencies both, in macro- and micronutrients. After malabsroptive and combined types of bariatric procedures, malabsorption of protein and protein-soluble fats and vitamines (A, D, E, K) as well as iron, calcium, B vitamins (B_1, B_6, B_{12} and folic acid) [8, 9, 18, 40]. Resection or reduction of the stomach results in decreased digestion and absorption of protein, iron, vitamin B_{12} and other nutrients provided along with animal protein products. Restrictive methods require consumption of very small meals which may lead to deficiencies in nutrients. What is more, frequently occurring nausea and uncontrollable vomiting caused by consuming too big portions may lead to the intensification of nutritional deficits and dehydration of the organism.

Due to vitamins and minerals deficiencies in patients after bariatric procedures, routine supplementation is recommended. According to current recommendations of American experts standard vitamin-mineral supplements (containing 400 μg/day of folic acid) should be applied with 1 pill 2 times a day [18, 28, 40]. Chewable or liquid formulas are preferred [16, 26, 27]. Recommendations about vitamins and minerals supplementation consider mainly application of calcium (in the form of calcium citrate) in the amount of 1200-2000 mg/day, vitamin D in the amount of 1000 – 2000 IU/day and for menstruating women also elemental iron (with vitamin C) in the dose of 40-65 mg per day. In case of vitamin B_{12} deficiencies, supplementation should be started with 500 μg/day orally or 1000 μg/month intramuscularly. In case of patients after BPD/DS, vitamin A should be also supplemented in the amount of 5000-10000 IU/day as well as vitamin K in the amount of 300 μg/day [18, 28, 40].

Each patient after bariatric procedure should be under long term dietetic control in order to determine and develop appropriate nutritional habits. Research indicates that patients under dietetic control achieved better results in body mass loss after the operation than those who did not receive such help [13, 35].

CONCLUSIONS

Proper way of nutrition after bariatric procedure not only helps with body mass loss and prevents regaining weight but also may protect against intolerances and nutritional deficits, mitigate them and prevent serious postoperative complications.

Conflict of interest

The authors declare no conflict of interest.

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