

Validity and efficacy of diets used for preoperative weight reduction among patients qualified for bariatric surgery

Zasadność oraz skuteczność diet stosowanych w celu przedoperacyjnej redukcji masy ciała u pacjentów kwalifikowanych do operacji bariatrycznej

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A – Study Design
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ABSTRACT:

Introduction: Bariatric surgery is the most effective method of weight reduction among patients suffering from morbid obesity. Reduction of body weight before surgery is an important element.

Aim: The aim of the study was to present the current knowledge on preoperative weight reduction and diet for this purpose.

Material and methods: To achieve the aims of the paper, we used articles available in the PubMed/MEDLINE database published in 2005–2020, as well as the guidelines of societies such as Metabolic and Bariatric Surgery Chapter of the Association of Polish Surgeons, American Association of Clinical Endocrinologists, The Obesity Society and American Society for Metabolic & Bariatric Surgery, International Federation for Surgery of Obesity and Metabolic Disorders-European Chapter and European Association for the Study of Obesity.

Results: Studies show that even a modest reduction in weight in the early preoperative period facilitates surgery and reduces the number of complications. The available data do not support the effect of preoperative weight loss on increased postoperative weight loss. The use of balanced, energy-restricted diet in the preoperative period prepares the patient for changes in the way of nutrition, which improves the nutritional status of patient. Low calorie (LCD) or very low calorie (VLCD) diet can be an effective method of weight loss before surgery, however, this approach does not allow to modify eating habits. The use of a very low calorie ketogenic diet (VLCKD) remains under discussion.

Conclusion: There is a need for large randomized trials to assess short- and long-term benefits of preoperative weight loss and methods of weight loss among patients qualified for bariatric surgery, also the standardization of nutritional management in the preoperative period.

KEYWORDS:

bariatric surgery, obesity, preoperative weight loss

STRESZCZENIE:

Wstęp: Operacje bariatryczne są obecnie najskuteczniejszą metodą redukcji masy ciała u pacjentów chorujących na otyłość olbrzymią. Istotnym elementem przygotowania do chirurgicznego leczenia otyłości jest redukcja masy ciała.

Cel: Celem pracy było przedstawienie dotychczasowej wiedzy na temat przedoperacyjnej redukcji masy ciała oraz diet stosowanych w tym celu.

Materiał i metodyka: W pracy wykorzystano publikacje naukowe dostępne w bazie PubMed/MEDLINE opublikowane w latach 2005–2020 oraz stanowiska i wytyczne towarzystw, takich jak: Sekcja Chirurgii Metabolicznej i Bariatrycznej Towarzystwa Chirurgów Polskich, *American Association of Clinical Endocrinologists*, *The Obesity Society*, and *American Society for Metabolic & Bariatric Surgery* oraz *International Federation for Surgery of Obesity and Metabolic Disorders-European Chapter* i *European Association for the Study of Obesity*.

Wyniki: Badania wykazują, że nawet niewielka redukcja masy w okresie poprzedzającym operację ułatwia jej przeprowadzenie, zmniejsza liczbę powikłań, umożliwia skrócenia czasu trwania zabiegu oraz hospitalizacji. Nie ma jednak jednoznacznych dowodów, że zwiększa ona redukcję masy ciała w okresie pooperacyjnym. Zastosowanie zbilansowanej diety ubogoenergetycznej w okresie przedoperacyjnym przygotowuje pacjenta do zmian sposobu żywienia, przez co poprawia jego stan odżywienia. Dieta niskokaloryczna (ang. *low calorie diet*; LCD) lub bardzo niskokaloryczna (ang. *very low calorie diet*; VLCD) mogą być skuteczną metodą redukcji masy ciała przed operacją, jednakże takie postępowanie nie pozwala na modyfikację nawyków żywieniowych. Zastosowanie diety bardzo niskokalorycznej ketogenicznej (ang. *very low calorie ketogenic diet*; VLCKD) pozostaje przedmiotem dyskusji.

Wnioski: Istnieje konieczność przeprowadzenia dużych badań randomizowanych oceniających krótko i długofalowe korzyści z przedoperacyjnej utraty masy ciała oraz metody redukcji masy ciała u pacjentów kwalifikowanych do operacji bariatrycznych, a także ujednoczenia kryteriów postępowania żywieniowego z chorym w okresie przedoperacyjnym.

SŁOWA KLUCZOWE: chirurgia bariatryczna, otyłość, przedoperacyjna utrata masy ciała

This article summarizes the current knowledge on the validity and efficacy of diets used for preoperative weight reduction among patients qualified for bariatric surgery.

ABBREVIATIONS

ALT – alanine aminotransferase
AST – aspartate aminotransferase
BMI – Body Mass Index
EASO – European Association for the Study of Obesity
EWL – excess weight loss
IFSO-EC – International Federation for Surgery of Obesity and Metabolic Disorders-European Chapter
LCD – low-calorie diet
RYGB – laparoscopic Roux-en-Y gastric bypass
NAFLD – nonalcoholic fatty liver disease
WHO – World Health Organization

INTRODUCTION

Multi-yearly epidemiological data have provided grounds for identifying obesity as the epidemic of the 21st century [1]. According to a 2016 report from the World Health Organization (WHO), nearly 650 million adults worldwide were obese [2].

Obesity is defined according to the Miniessay Body Mass Index (BMI = body weight [kg]/height [m]²). Class 1 obesity is diagnosed when the BMI is within the range 30–34.9 kg/m², i.e., class 2 when it is in the range 35–39.9 kg/m², and class 3 when it is equal to or greater than 40 kg/m². Additional categories were created for morbidly obese patients, i.e., class 3 obesity (super obesity) for BMI 50–59.9 kg/m² and class 5 obesity (super super obesity) for BMI ≥ 60 kg/m² [3, 4].

People with obesity are more likely to develop a number of other diseases such as: glycemic disorders, including type 2 diabetes, dyslipidemia, cardiovascular diseases, nonalcoholic fatty liver disease (NAFLD), obstructive sleep apnea, and cancer [5, 6]. WHO data shows that 35% of coronary heart disease, 55% of hypertension and 80% of diabetes in Europe are associated with overweight and obesity. Moreover, obesity is responsible for 10–13% of deaths, and obesity is linked to more deaths worldwide than underweight [7]. The numerous complications of overweight and obesity include psychological consequences, such as low self-esteem, lack of acceptance of one's appearance, social isolation, which have a negative impact on the quality of life level of obese people [8, 9].

Studies show that long-term and effective weight loss with the help of lifestyle modifications and pharmacotherapy is difficult to achieve, particularly in the case of morbid obesity [10]. Bariatric surgery is currently the most effective method for inducing long-term weight loss, as well as the treatment of obesity-related conditions [11].

In recent years there has been a steady increase in the number of bariatric surgeries performed. This trend is also noticeable in

Poland. Data from the National Health Fund show that there were 4,532 bariatric procedures performed in 2019, while in 2018 there were 3,790 [12]. According to Wałędziak et al. [13] laparoscopies account for 98.5% of all procedures. The most common type of surgery is laparoscopic sleeve gastrectomy (LSG), followed by laparoscopic Roux-en-Y gastric bypass (LRYGB) [13].

According to Polish recommendations, the minimum time to prepare for surgery should be 3 months, with the optimal period being 6–12 months. The Metabolic and Bariatric Surgery Chapter of the Association of Polish Surgeons recommends that a dietary intervention be applied for this time to allow a minimum 5% reduction in body weight or a 5% reduction in body fat [14, 15].

Preoperative weight loss is still the subject of discussion. Despite ample evidence of the benefits of losing weight over time, such as reduction in complications, less blood loss during surgery, and shorter hospitalization, the current recommendations of the American Association of Clinical Endocrinologists, the Obesity Society, the American Society for Metabolic & Bariatric Surgery, the International Federation for Surgery of Obesity and Metabolic Disorders-European Chapter (IFSO-EC), and the European Association for the Study of Obesity (EASO) lack clear guidelines for preoperative weight reduction [16, 17].

There are plenty of diets that have additional, both positive and negative health consequences for the patient beside weight loss. Their use depends on factors such as comorbidities and time to prepare for surgery.

THE USE OF WEIGHT REDUCING DIETS IN THE PREOPERATIVE PERIOD AND POSTOPERATIVE WEIGHT REDUCTION

Retrospective studies have shown a relationship between preoperative weight loss and the persistence of the effect of surgery in the form of increased weight loss in the postoperative period. In one study, Hutcheon et al. [18] assessed patients undergoing SG and RYGB surgery. Prior to the procedure, all participants used a low-calorie diet (LCD) with an energy content of 1,200 kcal (45% of energy from carbohydrates, 35% of energy from protein, 20% of energy from fats). The diet was implemented using OPTIFAST meal replacement products providing 800 kcal per day (100 g of carbohydrates, 70 g of protein, 15 g of fat, 100% of the daily-recommended amount of vitamins and minerals) and 1 meal prepared by the respondent (from 85 to 115 g of a lean product containing protein, 1 to 2 cups of cooked or raw non-starchy vegetables, 0.5 to 1 cup of fruit, ≤ 1 tablespoon of fat). Patients were also advised to consume at least 2,200 ml of zero-calorie, decaffeinated and non-carbonated drinks daily and to engage in moderate to vigorous physical activity (30 minutes/day). The goal was for patients to achieve

a minimum of 8% of excess weight loss (EWL) within 4 weeks. The patients were then divided into 2 groups, i.e., study participants who had achieved the set goal and those who did not. It was shown that patients with %EWL \geq 8% EWL before surgery achieved higher % EWL than patients with % EWL $<$ 8, both after 3 months ($42.3 \pm 13.2\%$ vs $36.1 \pm 10.9\%$, $p < 0,001$), 6 months ($56.0 \pm 18.1\%$ vs $47.5 \pm 14.1\%$, $p < 0.001$) and 12 months after surgery ($65.1 \pm 23.3\%$ vs $55.7 \pm 22.2\%$, $p = 0.003$). Similar conclusions were reached by Giordano and Victorzon [19], who analyzed the results obtained in 548 patients undergoing LRYGB. The subjects were encouraged to follow a low-calorie diet for 2–4 weeks before surgery in order to reduce their current body weight by approx. 8%. The patients were divided into three groups based on the extent of the achieved effect (group A – reduction $<$ 5% of the current body weight; group B – reduction of \geq 5% and \leq 10%, group C – reduction of $>$ 10% of the current body weight). It was shown that the mean loss of excess body weight 12 months after surgery was significantly greater in group C compared to group A (% EWL – 72.7% vs % EWL – 63.1%; $p = 0.015$, respectively). On the other hand, the study from the Scandinavian Obesity Registry [20], conducted in a large group of patients undergoing RYGB ($n = 20,564$) showed that weight loss attained preoperatively was positively correlated with sustained weight reduction, with the greatest effect observed with preoperative BMI $>$ 45.7 kg/m² 12 months after surgery ($p < 0.001$). This relationship was not confirmed by Horwitz et al. [21], who compared the group of patients undergoing the compulsory preoperative weight reduction program with the group not participating in this program. For each group, the results obtained after 12 months and 24 months from surgery were similar. Analysis of the data obtained from insurance companies requiring the participation of bariatric surgery candidates in weight reduction programs for treatment reimbursement showed that there is insufficient evidence that preoperative weight loss has a clear effect on postoperative outcomes [22]. Moreover, in 2016 the American Society for Metabolic and Bariatric Surgery [23] published an updated position paper emphasizing that preoperative weight loss required by insurance companies does not affect the subsequent effects of surgery.

Therefore, the studies do not provide conclusive data about the relationship between preoperative weight loss and long-term outcomes of increased weight loss. However, there is ample evidence of other benefits of preoperative weight loss.

THE USE OF VARIOUS WEIGHT REDUCING DIETS IN THE PREOPERATIVE PERIOD AND HEALTH BENEFITS

Surgical laparoscopic procedures provide a challenge in patients suffering from morbid obesity due to the considerable accumulation of visceral adipose tissue, increased liver volume and hepatic steatosis. Moreover, Gils Contreras et al. demonstrate that [24] the use of a low-calorie diet with increased protein content may improve the patient's nutritional status and facilitate the introduction of dietary recommendations after surgery. Nutritional deficiencies are a significant problem amongst candidates for surgical treatment of obesity, and they mainly include deficiencies in vitamin B12, folic acid, iron, vitamin D3, as well as copper, zinc and vitamin A. This group of patients is also found with low ferritin levels and serum albumin levels, indicative of qualitative malnutrition. Bariatric surgery contributes to the emergence and aggravation of the existing nutritional

deficiencies by affecting food intake and nutrient absorption. The British Obesity and Metabolic Surgery Society guidelines emphasize the need to identify and treat nutritional deficiencies in the run-up to bariatric surgery. The patient's preoperative nutritional status is improved by a well-balanced diet [25].

Considering the above statements, preoperative nutritional intervention represents a major element in the management of patients qualified for bariatric surgery. Treatment of obesity requires the patient's cooperation with a team of specialists, including, in particular, a doctor, a psychologist, and a dietitian. The task of the latter is to make patients aware of the mistakes that they are making, correct them and establish proper eating habits. For this purpose, the patient should keep a food journal. The journal should contain a record of the time when meals are eaten, their composition and the weight/amount of food, food, drinks and snacks consumed. Keeping a food journal enables the assessment of the energy and nutritional value of the patient's current diet, identification of the most common mistakes and their correction. The recommended energy deficit in a low-energy diet should be from 500 to 1000 kcal/day. According to the European Guidelines for Obesity Management in Adults [10], the average energy deficit to induce weight loss of 0.5 kg/wk is about 500–600 kcal/day, however, it should be individually adjusted to the patient. This goal can be achieved by regulating the diet and education leading to conscious choice of products. Dietary recommendations should emphasize the need for both qualitative and quantitative changes in the diet: increasing consumption of vegetables, fruits, whole grain cereal products, low-fat dairy products, and eliminating processed products that are sources for saturated fat and trans fat, sodium, and those containing sucrose and fructose. The patient should eat meals every 3–4 hours, with the first meal being eaten within the first hour of waking and the last meal 2–3 hours before bed. A major issue is also menu planning. The patient should also skillfully select food products, analyzing their composition. The consumption of salty and sweet snacks, as well as sweet drinks and alcohol should be abandoned. In addition, attention should be paid to the circumstances in which food is eaten. During this time, it is worth introducing some postoperative recommendations, e.g., chewing foods very thoroughly, eating in a calm atmosphere, avoiding eating meals while performing other activities (e.g., watching TV), avoiding drinking while eating a meal, 30 minutes before and up to 30 minutes after. The introduction of the abovementioned principles enables weight reduction before surgery and preparation for postoperative nutrition [27]. Even a modest reduction in weight can have a positive effect on health. European recommendations emphasize that diets characterized by altered proportions of macronutrients (low-fat, low-carbohydrate or high-protein) do not allow for greater weight reduction than a balanced low-energy diet. Moreover, an individualized low-energy diet provides the best chances of sustained success in the form of permanent weight loss [26].

Obesity raises the risk of complications, and an enlarged liver may impede the access to the gastrointestinal tract, sometimes forcing an open procedure and increasing the risk of bleeding [28]. Research shows that NAFLD may affect up to 85% of morbidly obese patients [29]. NAFLD additionally contributes to increased fragility of the liver, and thus a higher risk of intraoperative bleeding [30]. Preoperative weight loss has been shown to reduce the risk of the listed perioperative complications, such as reduced liver

volume and visceral fat [31, 32]. A good example of a dietary regimen that has a beneficial effect on liver volume, the content of visceral adipose tissue and lean body mass is the Mediterranean diet, which is confirmed by the results of research by Schiavo et al. [33]. That said, there is a lack of more studies confirming the effectiveness of this type of diet in patients preparing for bariatric surgery.

Regardless of the type of short-term nutritional intervention used, daily dietary energy supply is important. According to Tabesh et al. [34], the recommended caloric content of the LCD diet should be from 800 to 1200 kcal/day, and the VLCD from 500–800 kcal/day. The implementation of the LCD diet recommendations may be based on the consumption of standard food products and supplementation with preparations with a high-protein content. This type of intervention is recommended for diabetic patients preparing for surgery. In the case of the VLCS diet, full precautions shall be taken. It is especially important to monitor protein intake to limit the loss of lean body mass. The use of this dietary intervention can cause side effects such as gallstones, headaches and dizziness, electrolyte imbalance, and constipation. The VLCD diet is most often used for rapid weight loss when the time needed to prepare the patient for surgery is limited [34]. VLCD diets can be implemented through the use of meals prepared from standard foods and ready-made meal replacements.

The analysis of research results by van Wissen et al. [35] showed that the use of low-calorie diets (from 456 kcal/day to 1520 kcal/day) lasting from 2 to 12 weeks allows for liver volume reduction, and the extent of the effect depends on the duration of nutritional intervention. The results of Wolf et al. [36] not only confirm that a 2-week LCD diet (1200 kcal/day) has a positive effect on the volume of the liver, but its structure and functions are also affected by reducing steatosis, inflammation, which is reflected in the activity of alanine aminotransferase (ALT) and aspartate (AST) in the serum. In this study, the patient's daily food ration consisted of the following meals: 2 protein shakes per day, providing 20–30 g of protein per serving and no more than 200 kilocalories, followed by a dinner meal consisting of a protein product (90–180 g) and vegetables (1 cup) and 2 snacks to choose from: fruit, 180 g of skimmed Greek yoghurt or another cocktail protein. In addition, another study showed that a weight reduction of $\geq 8\%$ EWL achieved by following the LCD diet (1200 kcal/day) for 4 weeks reduced the duration of surgery and postoperative hospitalization [18]. The benefits of using the LCD regimen were also confirmed by Ekici and Ferhatoglu [37]. However, they authors emphasized that some patients preparing for bariatric surgery have difficulties with implementing the assumed dietary restrictions. Gils Contreras et al. [24] indicated that patients preparing for bariatric surgery obtain better results in the form of preoperative weight loss thanks to the VLCD (very low-calorie diet) diet, providing 800 kcal/day, rather than with LCD diets (1200 kcal/day). Both dietary interventions had similar effects on biochemical parameters, liver volume, incidence of surgical complications, and length of hospital stay.

Faria et al. [38] demonstrated that a VLCD diet (760 kcal/day) consisting of only liquid meals (yogurt, skim milk, vegetable cream soup) and lasting 14 days enables greater weight loss, reduction of visceral fat and shorter duration of surgery compared to a regimen based on food products of various consistencies (grilled chicken breast) with vegetables, fresh fruit, bread). Despite these benefits, it was shown that the recommendations of the liquid

diet were followed by merely 28% of respondents. In a study by Van Nieuwenhove et al. [39], 10.7% of the patients did not follow the recommendations of the VLCD diet, based on liquid meal replacement products, and the cause of failure was, among others, diet intolerance. Unfortunately, there are a number of contraindications to the use of industrially processed liquid VLCD diets, including arrhythmias and heart failure, unstable coronary artery disease, severe chronic kidney, pancreatic and liver diseases [40].

One of the newest methods of preoperative weight reduction is the VLCKD diet (very low-calorie ketogenic diet). The primary application of the ketogenic diet was the treatment of children with drug-resistant epilepsy. Subsequent studies have shown that the use of a low-calorie nutritional regimen based on the principles of the ketogenic diet enables rapid weight loss while maintaining lean body mass, which was the basis for creating the guidelines for the VLCKD diet [41].

The VLCKD diet involves a significant reduction in carbohydrate consumption, usually to approx. 13% of energy, with an increased consumption of fats (approx. 44% of energy) and protein (approx. 43% of energy), providing an average of approx. 800 kcal/day [42, 43]. In its highly restrictive variant, the diet should provide 90% of energy from fats, and 10% of energy from proteins and carbohydrates [44]. It is estimated that the use of VLCKD in obese patients has a beneficial effect on body composition, lipid profile, and the expression of inflammatory genes. In a study by Merra et al. [43] obese patients were randomly assigned to one of the three groups using the VLCKD diet with the calorific value calculated by subtracting 1000 kcal from the value of resting metabolism, assuming a maximum daily carbohydrate intake of 50 g. In the VLCKD1 group, half of the daily protein intake was supplemented by whey protein. The diets from the VLCKD2 and VLCKD3 groups differed from the VLCKD1 diet in a lower carbohydrate content. For the VLCKD2 group, it was < 35 g of carbohydrates (including $> 80\%$ of energy from carbohydrates came from simple sugars) and for the VLCKD3 group it was < 30 g of carbohydrates (including $> 35\%$ of energy from complex carbohydrates). Each diet caused a reduction in the patients' body weight. Additionally, in the VLCKD2 group there was a decrease in waist circumference ($p = 0.02$) and total fat mass ($p < 0.05$), in the VLCKD1 group a decrease in the concentration of LDL-C ($p < 0.01$) and serum HDL-C ($p < 0.01$), and in the case of the VLCKD3 group, a reduction in CRP protein concentration ($p = 0.02$). In turn, Albanese et al. [45] demonstrated that the use of the VLCKD diet results in lower blood loss and higher hemoglobin levels after bariatric surgery, which are associated with improved wound healing, and thus a lowered risk of complications following leaking intestinal anastomosis. Leonetti et al. [46] noted that a short-term VLCKD diet is safe and effective, and does not adversely affect kidney and liver function. However, despite the benefits shown in previous studies, it should be noted that there is relatively little data on the use of the VLCKD regimen for preoperative weight loss. Moreover, it has been demonstrated in animal models that a ketogenic diet based on products that provide high amounts of protein is associated with a significant excretion of nitrogen compounds and may contribute to kidney damage [47]. Excess supply of protein with diet can also lead to acidification of the body and electrolyte imbalance. It should also be borne in mind that both high-protein and high-fat diets provide considerable amounts of cholesterol and saturated fatty acids, raising the chance of developing atherosclerosis [40]. Nevertheless,

in recent years it has gained popularity as a diet favoring weight reduction. The main benefits increasing interest in such nutrition are the reduction of hunger and the rapid feeling of satiety [48]. The growing popularity of the ketogenic diet is also due to its beneficial effect on the mood and the potential antidepressant effect [49]. Moreover, a systematic review and meta-analysis of 13 studies on the safety and effectiveness of VLCKD diets in overweight and obese patients showed that they were associated with normalization of glycaemia, reduction of serum triglycerides and total cholesterol, reduction of systolic and diastolic blood pressure, and lowered serum concentration of ALT and AST [48].

To finish with, it is worth emphasizing that excessive and sustained dietary restrictions are not associated with better outcomes in the form of a greater reduction in fatty liver [31].

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CONCLUSIONS

There are many advantages of preoperative weight reduction in patients qualified for bariatric surgery, including weight loss (fat loss), reduced liver volume and visceral fat, lowered risk of postoperative complications (including bleeding), and shortened surgery time and hospitalization as well as preparation for postoperative changes in diet. The effectiveness of short-term weight loss diets, i.e., LCD and VLCD, has been widely documented in the literature, while the validity of the VLCKD diet is still arguable. Any model of preoperative dietary intervention involves the need for performing randomized trials to verify if preoperative weight loss affects postoperative weight loss. More attention should be paid to the need to standardize the criteria of nutritional management in order to ensure preoperative weight loss.

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