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The Place of Bariatric and Metabolic Surgery in the Treatment of Morbid Obesity

Adilova N. Sh., Shagazatova B. Kh.

Department of Internal Medicine №2 and Endocrinology, Tashkent Medical Academy, Uzbekistan

Abstract The use of bariatric surgery in patients with obesity and type 2 diabetes mellitus has its own characteristics. This review article describes the effects of various types of bariatric surgery on cardiovascular risk factors and the mechanisms of their effect on carbohydrate and lipid metabolism. The results of restrictive and bypass bariatric surgeries in patients with obesity and type 2 diabetes mellitus were demonstrated.

Keywords Obesity, Cardiovascular risk factors, Endothelial dysfunction, Gastric bypass, Bariatric surgery

1. Introduction

Adipose tissue is an endocrine organ that produces hormones, cytokines, and proteins in an endocrine and paracrine manner that affect the activity of cells and tissues in the body. [22]. It also serves to maintain lipid and glucose homeostasis, but with increasing body weight, the function of this tissue is disturbed, causing obesity and affecting the activity of cells and tissues. [13]

Obesity - chronic, neuropsychological, multifactorial disease, which is defined by metabolic psychosocial effects on human health as a result of excess fat accumulation, adipose tissue dysfunction, and biomechanical effects of fat on adjacent organs and causes life-threatening diseases. [3]

It is defined by imbalance between white and brown adipose tissue and as a result, it causes changes in glycolysis, gluconeogenesis, and lipid metabolism. The increase in obesity is observed mostly among the urban population and is a consequence of the imbalance between energy consumption and expenditure.

Nowadays approximately two thirds of the world population i.e. almost 2,2 billion people have excess body weight, about 712 million (10%) people are obese. [10]

Occurrence between male is 11% and between female is 15%. By 2030 it is assumed that 60% of the world population i.e. 3,3 billion people will have excess weight and 1,1 billion people will be obese. [41]

As of 2019, Uzbekistan ranks 123rd in the ranking of countries on obesity, and the prevalence of this disease among the population over 18 years old is 16.6%, and 48,2% has excess weight. [26]

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2. Impact of Bariatric Surgery on Cardiovascular Risks

Obesity is a risk factor for the development of several serious diseases, including cardiovascular, metabolic and oncological diseases [13]. The increase of obesity in its turn will cause increasement in diseases related to it. For example, due to the rise of type II-diabetes mellitus, in 2021 American Diabetes Association (ADA) has lowered the age limit screening for carbohydrate metabolism disorders between population from 45 years to 35 years. [39]. According to the INTERSALT study, every 4.5 kg increase in body weight leads to a 4.5 mm Hg increase in systolic arterial pressure [17]. Some cancers are associated with high BMI, such as 11% of rectal cancer, 9% of postmenopausal breast cancer, 39% of endometrial cancer, 25% of kidney cancer, and 37% of esophageal cancer are associated with obesity. Along with that, more than 65% of all obesity-related cancers are endometrial, postmenopausal breast, and colorectal cancers. [42] In addition, obesity causes excessive strain on joints, impairs their function and mobility, and also causes obstructive sleep apnea by derailing lung function [34].

If alimentary obesity is not eliminated in time, it causes metabolic syndrome in the patient. The main symptoms of this syndrome are visceral obesity, increased arterial blood pressure, hypercholesterolemia, hypertriglyceridemia, and dietary hyperglycemia. [15,51].

Obesity is known to be a major risk factor for cardiovascular disease [47]. CVD is one of the leading causes of death in the world, accounting for approximately 31% of all deaths or approximately 18 million people annually [23]. Abdominal obesity, regardless of its level, plays a key role in the development of the risk of CVD. [14]

There are 2 types of risk factors for cardiovascular disease: controllable and uncontrollable risk factors. Controllable risk factors include physical inactivity, poor diet, obesity, arterial

hypertension, diabetes mellitus, smoking, mental retardation, and dyslipidemia. Uncontrollable risk factors include the patient's age, sex, genetic predisposition.

Central redistribution of body fat also leads to the production of inflammatory cytokines. These cytokines, such as tumor necrosis factor-alpha and interleukin-6, cause muscle wasting and sarcopenia due to their catabolic effects [18,35]. An increase in F2a prostaglandin, a biomarker of the oxidation process, is also observed in plasma and urine [2,16].

Recently, there is an increasing trend of obesity prevalence in Asian countries due to imbalance in nutrition and low physical activity. Asian populations have specific characteristics of obesity: Despite having the same or lower BMI, Mongoloid peoples have higher body fat and less skeletal muscle mass than European peoples. At the same time, excess fat accumulates in the abdominal organs and liver (nonalcoholic fatty liver disease) leading to cardiometabolic risk, morbidity, and mortality. [11,21,28,29,37,38,40,52]

Due to the reasons listed above, the criteria for the diagnosis of overweight and obesity in Asian populations, as opposed to non-Asian populations, required modification [21,29,38,40,52]. It is known that the prognostic value of waist circumference in determining the presence of metabolic syndrome is higher than that of BMI. However, waist circumference does not include measurement of height, so there may be limitations in predicting the risk of CVD in tall and short patients. However, although BMI reflects the composition of muscle and fat mass, it has an important advantage: BMI is easy to measure, which is convenient for the primary health care system.

Between different ethnic groups in Asia, even when the BMI is the same, there can be a difference in the percentage of body fat. However, in general, Asians have a higher cardiometabolic risk compared to non-Asian populations with the same BMI range. Therefore, this anthropometric indicator is used to diagnose overweight or obesity in Asian populations [40,43]. Generally, BMI thresholds for overweight and obesity should be lower for Asians. These criteria are debated and may differ between Asian populations with different ethnic characteristics in different countries. In 2019, the ADA (American Diabetes Association) Diabetes treatment care standards of Care section of the Obesity Management section highlights BMI limits developed for Asian Americans [1].

For several decades, the fight against obesity and associated diseases has been a priority of the health care system, which requires the development of effective treatment strategies and effective prevention methods. [4]. It is known that obesity treatment is based on lifestyle changes, i.e. diet, increasing physical activity and drug treatment. In addition to drug treatment, lifestyle changes can lead to a 5-15% reduction in body weight. Also, about 90% of patients return to their pre-treatment body weight or gain more weight within the next 5 years. Even when using combined non-surgical methods, it is not always possible to achieve satisfactory results, especially in morbidly obese patients with BMI ≥40 or BMI ≥35 kg/m2 and concomitant diseases. [4,32]. This motivated the treatment of this disease not only by a conservative method, but also by a surgical method.

In addition, bariatric surgery, i.e., surgical treatment of pathological obesity, is perceived by the WHO as a standard method in the treatment of morbid obesity. Bariatric surgery not only treats morbid obesity and leads to 60-70% excess weight loss in 1 year [39], but also has a positive effect on atherosclerotic cardiovascular diseases [17]. In 2013, 468,609 such surgeries were performed in the world. (Angrisani et al., 2015). In France, the number of surgical procedures increased 20-fold between 1997 and 2016 – from 2,800 to almost 60,000 procedures per year (Oberlin and Peretti, 2018). In Turkey, although less than in France, the number of annual surgical procedures increased from 2,197 in 2008 to 4,511 in 2012 ("Turkish Statistical Institute Turkey Health Survey 2016", 2017).

Currently, in the context of the increasing trend in the number of overweight and obese patients, the study of the mechanisms of its development and the development of treatment methods are undoubtedly relevant [13,26]. According to the 2020 clinical recommendations of the Russian Association of Endocrinologists and the Association of Bariatric Surgeons, surgical treatment of obesity is recommended for patients under the age of 60, with ineffective conservative treatment (regardless of the presence or absence of comorbidities), with morbid obesity with BMI>40 kg/m2, or BMI >35 kg/m2 and related diseases (type 2 diabetes, joint diseases, obstructive sleep apnea, etc.). As a rule, in actual practice, candidates for bariatric interventions are considered to be patients under the age of 60, but indications for bariatric surgery can be considered in other age groups as well [12]. In particular, according to the recommendation of the WHO, for Asian peoples, patients with symptoms of metabolic syndrome are indicated for surgery, even if the BMI is higher than 27 kg/m2, because Asian countries, including Uzbekistan, are among the countries with a high risk of CVD. [20]

Bariatric surgery methods are divided into several types: SLEEV-resection, gastroshunt, jejunoileo-shunt, biliopancreatic shunt, etc.

Currently, SLEEV-resection is the most frequently performed procedure in metabolic and bariatric surgery, accounting for 46% of all operations worldwide. Studies have shown a 40% reduction in cardiovascular disease risk and remission or improvement rates for arterial hypertension, type 2 diabetes, and dyslipidemia (68%, 78%, and 71%, respectively) after metabolic and bariatric surgery [24].

The concept of "metabolic surgery" was explained for the first time by H. Buchwald and R. Varco in the monograph "Metabolic Surgery" compiled in 1978 as "surgical management of normal organs and systems in order to achieve biological results in improving health." [9]. This monograph was based solely on the publications on significant improvement of type 2 diabetes after several bariatric operations (jejunoileoshunting, gastroshunting, biliopancreatic shunting, etc.) for the purpose of reducing

body weight [30,33,44]. In the 90s of the 20th century, Pories W. and co-authors first discussed the possibility of normalizing carbohydrate metabolism after gastroshunt [45,46]. Later, this surgical procedure was rightfully considered the "gold standard" of bariatric surgery. Gastroshunting is considered a combined bariatric surgical procedure, because its metabolic effects include both the restrictive component (transverse resection of the stomach) and the shunting of various sections of the small intestine, that is, the duodenum and the initial part of the small intestine are excluded from digestion, which reduces food absorption. The mechanism of metabolic action of gastroshunt consists of reducing the volume of the stomach, which means: transition to a low-calorie diet in the early periods after surgery contributes to the normalization of glycemia; reduces visceral fat reserves against the background of body weight loss; due to the removal of the fundal part of the stomach that produces ghrelin, it reduces the feeling of hunger and reduces appetite; in addition, an additional incretin effect is also manifested as a result of a faster influx of chyme into the ileum (where L-cells produce glucagon-like peptide-1) and a change in the interaction of intestinal peptides. [19,31].

The practice of gastroshunting, which includes restrictive and shunting components, has its own complexity and the risk of developing side effects. Nevertheless, this type of surgical practice guarantees clear, stable and long-term results. It also has a positive effect on the course of diseases associated with obesity. This is its main advantage. Gastroshunting showed a positive effect on type 2 diabetes: according to scientific literature, normoglycemia was achieved in 84% of patients after this procedure [6-8]. In the following years, the beneficial effects of Gastroshunting practice, such as reducing body weight, improving treatment of type 2 diabetes, and even remission, have been proven in other scientific studies.

Mingrone G. and co-authors compared patients after 2 years of gastroshunting and conventional drug therapy, and 75% of patients in the group who underwent gastroshunting achieved remission (postprandial glucose <5.6 mmol/l or glycated hemoglobin <6.5%) and reported that none of the patients in the conventional treatment group had remission. [36] A subsequent 5-year comparison by Schauer P. et al showed that glycated hemoglobin <6.0% was achieved in 29% of patients after gastroshunting and in 5% of patients after conventional treatment. [50]. Similar studies by other scientists have shown, among other things, the positive effect of gastroshunting on lipid metabolism [5,25].

According to many authors, gastroshunting has a positive effect on arterial hypertension.

Thus, the research of Ikramuddin S. and co-authors shows that in 28% of patients with obesity, type 2 diabetes, dyslipidemia, and arterial hypertension, systolic hypertension was < 130 mm Hg was observed [27]. According to the results of a 5-year follow-up by the same authors, the results of achieving the target values of arterial blood pressure of patients in the gastroshunt group have a significant advantage over the results of patients in the group receiving conservative treatment (23% and 4%, respectively) [28].

In addition to the above positive effects, bariatric surgery can reduce or reduce the development of atherosclerosis in the early stages of atherogenesis, stop systemic inflammation, inhibit oxidative stress and endothelial dysfunction due to the reduction of body weight.

In conclusion, the study of the problem of obesity is relevant, and surgical treatment is considered to be more effective than conservative treatment.

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