Efficacy of Gastric Bypass in the Treatment of Obesity-Associated Carbohydrate Metabolism Disorders

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Abstract

We have operated on 42 patients ages 22 to62 suffering different forms of obesity and obesity-related metabolic disorders. Body mass indexes have ranged from 28 to 62 kg/m^2. All patients have had symptoms of metabolic disorders of different intensity. Our goal has been exerting maximal influence on carbohydrate metabolism processes rather than mere body weight reduction. The patients have undergone sleeve gastrectomy, laparoscopic mini-gastric bypass, Roux en Y gastric bypass, as well as modified gastric bypass with Rouxen Y gastrectomy with a 180-cm bypass and 70-cm alimentary loop as an independent way of surgical treatment of diabetes type 2 associated with obesity. Sleeve gastrectomy in terms of weight control has demonstrated a 73% efficacy, and gastric bypass –a 89% efficacy. The efficacy of surgeries in patients with carbohydrate metabolism disorders through Roux en Y gastric bypass has totaled 96%,classic Roux en Y gastric bypass - 92%, sleeve gastrectomy – 60%. Roux en Y gastric bypass andmini-gastric bypass are more effective in the treatment of obesity and associated metabolic disorders compared to sleeve gastrectomy. Gastric bypass has proved effective even in diabetes patients with body mass indexes up to 30 kg/m^2.

Keywords: *Obesity, metabolic syndrome, diabetes type 2, bariatric and metabolic surgery, gastric bypasss, mini-gastric bypass.*

Abstract

Today, the incidence of obesity has grown to proportions of an epidemic, especially in the civilized world. In 2016, more than 1.9 billion mature people above 18 were deemed overweight[1]. More than 650 million of those were diagnosed with obesity[2]. According to the World health organization (WHO), as of 2016, 39% of adults (men - 39%, women – 40%) were overweight[3]. In 2016, about 13% of mature population of the planet (men – 11%, women – 15%) were diagnosed with obesity[4]. Within a period from 1975 through 2016, the number of obese people tripled[5]. In Europe, the incidence of obesity ranges from 5% to 23% in men and from 7% to 36% in women[6]. In Uzbekistan, the percentage of overweight or obese people is 24.9%. According to WHO, obesity is a non-infectious epidemic of the 21st century[7].

In 2000, WHO came up with a proposal to lower the overweight threshold for the mongoloid race from 25kg/m^2 down to 23.5kg/m^2, and the obesity threshold – from 30kg/m^{2}down to 27.5kg/m^2[8]. The initiative was put forth because epidemiological research data had shown that mongoloids began to deal with overweight-related issues at a lower body mass index [4-8].

In cases when the body mass index reaches 40 kg/m^2 or higher, even when no complications are observed[9], morbid (pathological) obesity is diagnosed[10]. With complications, such as diabetes type 2, arterial hypertension, dyslipidemia, and lower limb joint pathologies, obesity is classified as morbid at a body mass index of 35 kg/m^2 or higher[11].

The body mass index is subject to criticism for not reflecting the fat/muscle ratio and distribution of fat around the body[12]. For example, it can classify an elderly person with low muscle mass as one with ideal weight, while a heavy-muscled athlete can be termed as overweight or obese. However, so far, body mass index is the only internationally recognized body weight evaluation criterion[13].

Over the past decades, scientists and clinicians have

switched to a complex approach to studying different metabolic disorders and obesity-related conditions[14]. They have concluded that these pathologies share symptoms and generalized them as "metabolic syndrome"[15].

Metabolic syndrome (X syndrome) is a kind of price we pay for urbanization, as it entails physical inactivity, improper nutrition, and sedentary life mode, which can cause serious health problems in future[16]. There is even a symbolic pattern of these consequences: metabolic syndrome – 10 to 20 years old - atherosclerosis – 10 to 20 years old – myocardial infarction, stroke[17].

A person can be diagnosed with metabolic syndrome if he or she has at least three of the following symptoms:

- Overweight;
- Arterial hypertension;
- High blood sugar;
- Dyslipidemia (abnormal lipid profile);
- Early atherosclerosis;
- Ischemic cardiac disease;
- Gout;
- Increased male hormone levels in women.

Today, the most effective and reliable method of morbid obesity treatment is bariatric surgery[18]. Operations that limit food intake and food absorption result in pronounced and continuous weight loss and mitigate the majority of associated conditions[19]. The effect lasts for lifetime, frees patients from having to follow strict diets[20], significantly improves and prolongs life[8,26,46]. Anti-obesity surgeries have been in practice since the 1950s, when the first jejunoileal bypass surgery was conducted in the USA[21]. Over the past 25 years or so, other types of bariatric surgeries have been developed and are now broadly applied (intragastric balloon placement, biliopancreatic bypass, lap band surgery, sleeve gastrectomy)[22].

Today, the number of anti-obesity surgeries per year in the world exceeds 340 000 (as of 2018) [18]. There are lots of factsproving the positive effect of bariatric operations, which lasts for long periods[23].

First of all, the effect of an operation depends on its type. Patients lose 45% to 95% of unhealthy weight, and the effect continues for 1 to 1.5 years[24]. If there are serious underlying conditions, simple bariatric surgeries may be ineffective, so more complex operations – gastric or biliopancreatic bypass – may be required[25].

The initial goal of bariatric surgeries is body weight control[26]. Later they proved effective against diabetes type 2, as it was observed in most patients, who had lost weight after an operation[27]. With different underlying signs of metabolic syndrome, most effects appear during the first month after the surgery[28]. In other words, diabetes, hypocholesterolemia and other symptoms go away before the patient loses weight[29]. This has produced the term "metabolic surgery", which means selective surgical correction of metabolic disorders [54].

In 2009, the American Diabetes Association included these operations in the standards that are applied in the treatment of diabetes type 2 and underlying obesity, and in the USA these operations are covered by insurance companies[30]. In some European (Italy, France, Great Britain) and other countries (Israel), surgeries required for treatment of morbid obesity are covered by medical insurance too[31].

Although there are tons of research and scientific publications concerning bariatric and metabolic surgery, there are lots of issues that still need to be resolved[32]. So far, there are no unified or universal standards that would regulate the use of bariatric surgeries based on indications and surgeon's choice[33]. Given the high spread and incidence of morbid obesity and related metabolic disorders in Uzbekistan[34], we actively use bariatric and metabolic surgery to treat this category of patients while relying on our own observations and studies[35]. Based on these studies, we have presented some results and conclusions concerning the choice of effective surgical tactics in the treatment of patients suffering carbohydrate metabolism disorders with underlying obesity and dyslipidemia[36].

Materials and Method

We operated on 42 patients at Clinic 1 of the Tashkent City Clinical Hospital over the period from 2015 through 2019, ages 22 to 62, dealing with various types of obesity and related metabolic disorders[37]. The body mass index ranged from 28 to 62 kg/m^2. All patients had symptoms of metabolic disorders of different intensity[38]. It should be noted that 20 subjects had applied for a surgery for lack or short duration of effects of conservative treatment (diet, physical exercise, use of dietary supplements)[39]; 22 patients had applied

for treatment due to diabetes type 2 (disease duration – 3 to 15 years)[40]; therefore (see a description below) our goal was to exert maximal influence on carbohydrate metabolism rather than mere reduction of body mass index[41], as we realized the inseparability of bariatric and metabolic procedures[42].

Prior to a surgery, the patients had undergone the following tests:

- Complete blood count;
- Biochemical blood count (ALAT, AST, uric acid, creatinine);
- Coagulogram;
- Blood clotting time;
- Carbohydrate metabolism indexes (blood sugar level; HbA1Cglycosolated hemoglobin; fasting and after-food insulin, if necessary; C-reactive protein);
- Lipid spectrum;
- Imaging: ECG, ultrasound, EGD;
- Other consultations (endocrinologist, diabetologist, hepatologist, cardiologist, therapist, emergency physician and anesthesiologist)[43].

A group of 8 patients underwent sleeve gastrectomy, 23–gastric bypass with Rous en Y (7 patients were subject to gastric bypass with Rous en Y as independent treatment of diabetes type 2 associated with obesity)[44], 11 patients were subject to mini-gastric bypass (MGB/OAGB) with the use of bypass and alimentary loops of different length (Table 1)[45]. Also, a group of 11 patients underwent laparoscopic mini-gastric bypass devised by R. Rutledge with the formation of a small stomach with a volume of 150 ml to 200 ml, and a 4cm to 5cm thick gastroenteroanastamosis was fixed over a length of 150cm to 200cm from the ligament of Treitz[46].

Table 1. Types of surgeries required to treat obesity and obesity-related diabetes type 2

Type of surgery	Sleeve gastrectomy	Roux en Y gastric bypassmodification	Roux en Y gastric bypass	Mini-gastric bypass
Obesity	8	-	7	5
Obesity combined with diabetes	-	7	9	6

Results and Discussion

During the early postoperative period, disease management required special care (control and correction of blood sugar and other indicators) during the first several days; later, all patients were managed on the Fast Track Recovery basis. All patients were discharged after 5 to 7 days with their state defined as satisfactory. Later, all patients were subject to regular monitoring for all related parameters (blood sugar, fasting and after-food insulin, weight loss dynamics, etc.)

Patients, who had sleeve gastrectomy, lost 25 kg of weight on average; it should be noted that after a year weight loss would slow down dramatically or stop completely (Fig. 1)

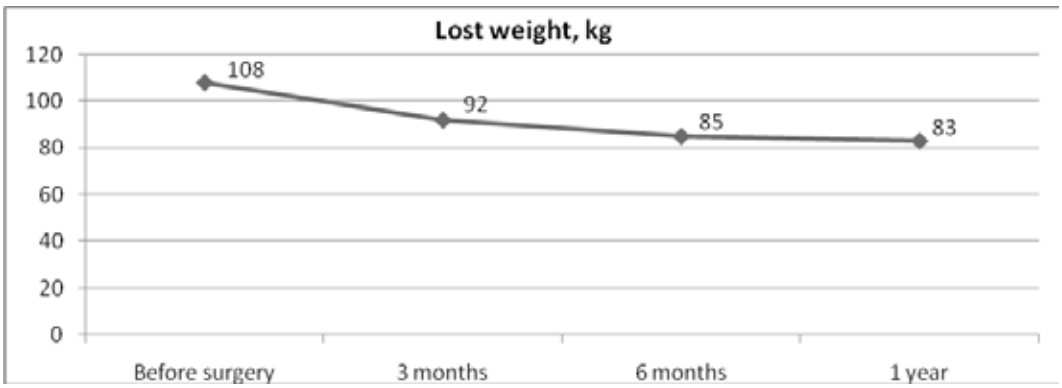

Figure 1.

On the average, patients lost 54 kg during the year following a gastric bypass surgery (Fig. 2).

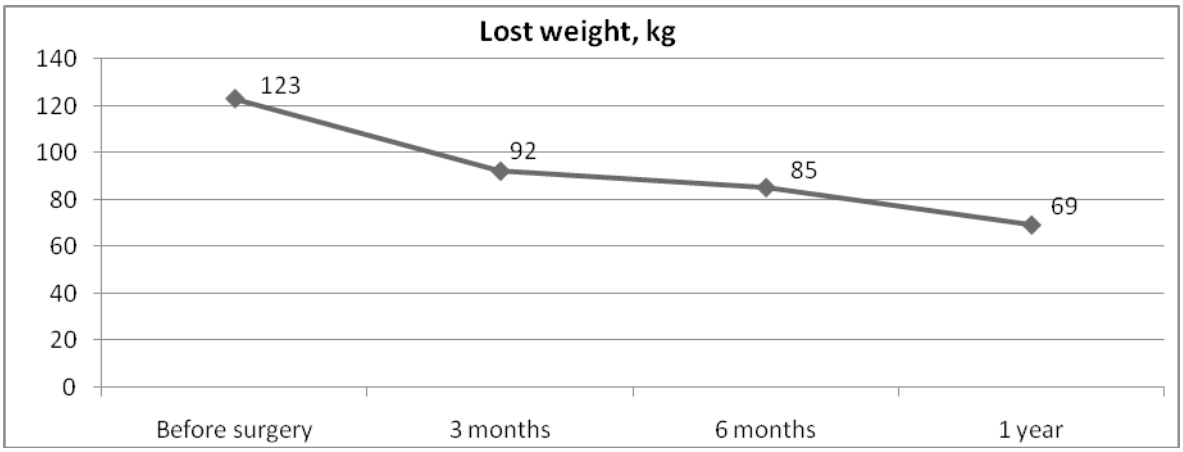

Figure 2.

The percentage of lost weight has been calculated according to the formula:

$$\text{EWL\%} = \frac{\text{Excess weight (kg) in the end}}{\text{Lost weight (kg)}} \times 100\%$$

and totaled 70%on average for sleeve gastrectomy cases and 85% for gastric bypass cases.

As mentioned above, 22 patients had diabetes type 2; therefore, the type of surgery was chosen with special consideration to the duration of the disease, clinical symptoms and their intensity, fasting and post-meal blood sugar and other metabolic syndrome indicators; however, special attention was paid to fasting and after-meal C-peptide, insulin and C-reactive protein blood levels, HOMA-IP, atherogenic and abdominal obesity indexes, which has enabled us to achieve an up to 98% accuracy in prediction of the efficacy of surgical diabetes treatment (Fig. 3). Also, a differential approach was applied to each patient with reference to carbohydrate and lipid metabolism indicators when choosing an optimal length of bypass and alimentary loops and stomach size. This has helped us achieve full and complete remission of diabetes in patients with a body mass indexof up to 30 without losing much of excess weight.

Test results of patients with carbohydrate metabolism disorders and their dynamics during the postoperative year demonstrating a complete remission of both clinical and laboratory diabetes indicators (Fig. 3 and 4)

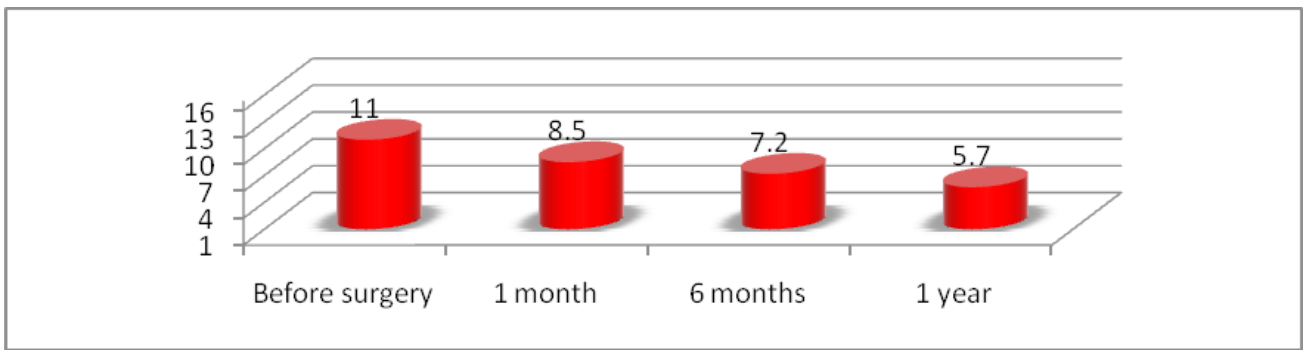

Fig 3. Average blood sugar level**

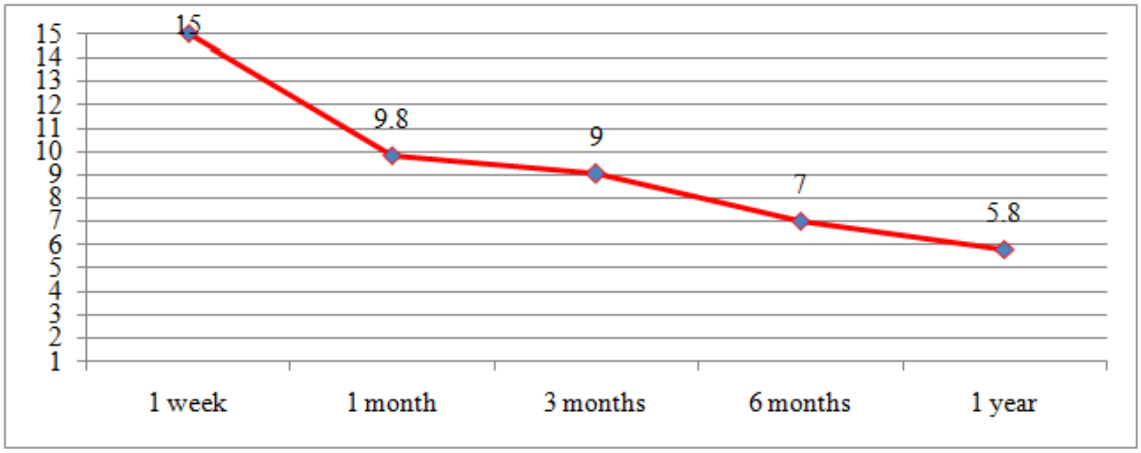

Figure 4. Blood sugar dynamics**

We detected normalization of insulin secretion in response to eating, which indicates a decrease in or disappearance of insulin resistance (Fig. 5).

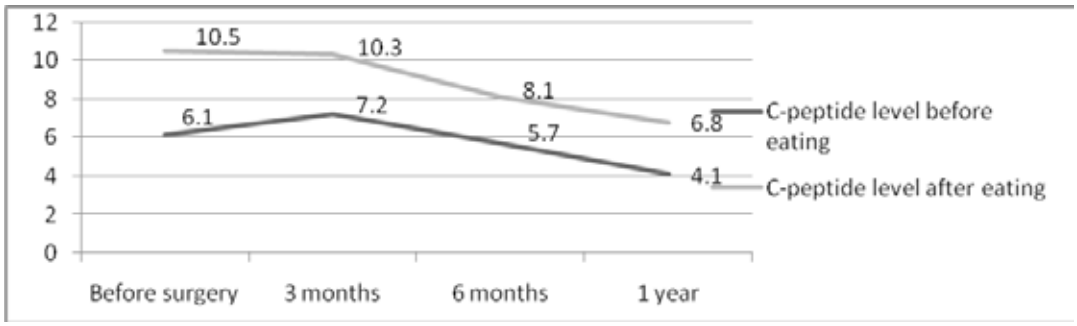

Figure 5. Postoperative C-peptide level

Also, it should be noted that six patients had been receiving 32 units of insulin on average before a surgery with blood sugar exceeding 10 mmol/l. Three patients canceled insulin injections within a month following a surgery due to a complete remission of diabetes; two patients cut down on insulin within three months following a surgery. Only one patient had to reduce insulin injections to a minimum of 10 units of simple (Actrapid) insulin per day.

All obesity patients demonstrated an increased C-reactive protein, which is a sign of metabolic syndrome; after an operation, C-protein levels would decrease as shown in Figure 6.

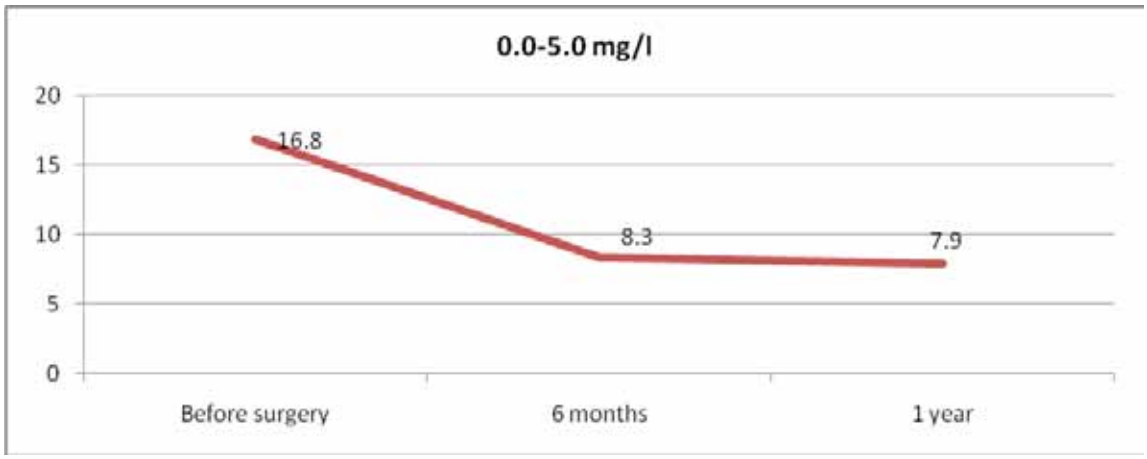

Figure 6. C-reactive protein level dynamics

Table 2. Pre-* and postoperative metabolic syndrome indicators**

	Before surgery*	After surgery (1 year)**	Norm
Blood sugar	9.81	5.8	4-7 mmol\l
Blood sugar after eating	12.9	6.7	4-7 mmol\l
Glycosylated hemoglobin	8.10	6.6	4-7%
Fasting insulin	20.4	0.2	0.7-9.0 mU/l
Insulin level after eating	32.1	6.6	0.7-9.0mU/l
Blood pressure	150/90	130/80	
Atherogenic index	5.0	4.8	Optimal up to 4

* All preoperative tests were made as the patients were taking medications and following strict diets (sugar-lowering, antihypertensive,etc.)

** All postoperative tests were made without the patients' aking of any medicines or following diets(sugar-lowering, antihypertensive, etc.)

Evaluation of the efficacy of bypass surgeries in the treatment of metabolic syndrome revealed a more pronounced weight and metabolic symptom reduction compared to restrictive surgeries (Table 3).

Table 3. Efficacy of bypass and restrictive surgeries

	Weight loss	Diabetes	Arterial hypertension	Dyslipidemia
Modified Roux en Y gastric bypass	98%	95%	92%	98%
Roux en Y gastric bypass	90%	90%	95%	90%
Mini-gastric bypass	85%	92%	85%	85%
Sleeve gastrectomy	73%	No data available	50%	40%

Table 4. Postoperative metabolic improvement in 42 (100%) patients

	Average BMI	Diabetes type 2	AH	Dyslipidemia	Other diseases (apnea, joint and spinal diseases)
Before surgery	38	52%	87%	98%	60%
After 3 months	35	4,6%	36%	40%	42%
After 6 months	32	2,3%	17%	21%	33%
After a year	29	2,3%	8%	9%	18%

We specified general and specific postoperative complications. One of the patients, who had undergone a modified Roux en Y bypass surgery, developed Potassium, Magnesium and Calcium microelement deficiency resulting in dysmetabolic polyneuropathy manifesting itself in different forms of paresthesia. General postoperative complications were observed in three patients; two of them had postoperative hernias, and one developed postoperative wound festering(Table 5); there were complications after the use of the traditional median approach only. No complications occurred after laparoscopic surgeries.

Table 5. Postoperative complications

	Lethal	Specific		General	
		Micro- and microelement deficiency	Dysmetabolic polyneuropathy	Hernia	Wound festering
Modified Roux en Y gastric bypass	0	1(2.3%)	1(2.3%)	1(2.3%)	1(2.3%)
Roux en Y gastric bypass	0	0	0	1(2.3%)	0
Mini-gastric bypass	0	0	0	0	0
Sleeve gastrectomy	0	0	0	0	0

Thus, the conclusion is that the most effective method of treatment of morbid obesity and associated diseases is gastric bypass surgery[47].

However, this type of surgery is technically challenging and may cause unfavorable postoperative reactions[48]; gastric bypass remains effective with the use of an individual approach to each patient and when determining the length of intestinal loops[49].

Sleeve gastrectomy is purely restrictive and therefore not very effective in the treatment of metabolic syndrome[50], and it has a high obesity recurrence rate, as patients may regain weight over several years following the surgery[51]. Gastric bypass is a kind of gold standard of surgical treatment of obesity and related disorders[52]. Non-invasive gastric bypass surgeries significantly reduce the occurrence of general surgical and specific complications[53].

Ethical Clearance: No ethical approval is needed.

Source of Funding: Self

Conflict of Interest: Nil

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