Central Asian Journal of Medicine

EVALUATION OF THE EFFECT OF LAPAROSCOPIC LONGITUDINAL GASTOECTOMY PRACTICE ON CARBOHYDRATE METABOLISM DISORDERS IN MORBIDLY OBESE PATIENTS

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ABSTRACT

Objective is to study and evaluate carbohydrate metabolism after laparoscopic longitudinal gastroectomy (LLG) in morbidly obese patients. **Materials and methods:** 231 bariatric and metabolic operations were performed in our clinical bases from 2016 to 2022, of which 82 were MGSh and 149 were LLG. **Result:** In our clinic, the effect of LLG practice on carbohydrate metabolism was studied and evaluated before practice and 6 months after practice. Among 11 patients with type 2 diabetes in our observation groups, clinical improvement of disease symptoms was observed in 3(27%) and complete remission in 8(73%) patients after LLG procedure. It is noteworthy that there were no patients whose clinical course of the disease remained unchanged after the operation. **Conclusion:** As a result of the corrective effect of laparoscopic longitudinal gastroectomy on existing metabolic indicators in patients suffering from morbid obesity, it improves the course of early postoperative period and concomitant diseases in patients, and has a positive effect on the clinical course of not only prediabetes, but also diabetes.

Key words: morbid obesity, bariatric surgery, laparoscopic longitudinal gastroectomy, metabolic syndrome, carbohydrate metabolism, diabetes.

INTRODUCTION

Obesity is a chronic, multifactorial, genetically determined, life-threatening disease caused by excessive accumulation of adipose tissue in the body, with serious medical, social, and economic consequences. It is one of the most common

chronic diseases in the world and has been described by the WHO(world health organization) as "the non-communicable epidemic of the late 20th - early 21st century"[6,10]. The development of obesity-related comorbidities, including type 2 diabetes, significantly increases the risk of cardiovascular disease. Weight loss in patients results in improved glycemic control [4]. Depending on the degree of obesity, there are conservative (increasing physical activity, diet therapy, pharmacotherapy) and surgical (gastric balloon, reducing the size of the stomach, gastric bypass) treatment methods, but only the surgical method is a radical treatment. The most effective treatment for obesity is bariatric surgery, which not only causes weight loss, but also improves glycemic control and leads to remission of type 2 diabetes [4]. Conventional treatment of type 2 diabetes includes lifestyle, dietary and physical activity adjustments, oral hypoglycemic drugs, or insulin therapy. In many cases, conservative treatment methods are unstable and often have insufficient clinical results, which makes achieving a stable remission of type 2 diabetes an impossible task and is the reason for conducting many studies. Short-term remission can be achieved in 10-40% of cases of type 2 diabetes, but long-term maintenance of this result is a great challenge[9]. A relatively new and promising type of diabetes treatment is bariatric surgery. In the treatment of diabetes, compared to bariatric surgical procedures with conservative treatment methods, after the operation, patients achieve not only compensation of diabetes, but also a complete and, most importantly, relatively stable remission[1,2].

Materials and methods. From 2019 to 2022, 231 metabolic and bariatric surgeries were performed in our clinic, of which 82 were minigastric bypass (MGB) and 149 were laparoscopic longitudinal resection (LLG). In recent years, the number of patients with morbid obesity has increased, and the scope of LLG surgery has increased accordingly. During these years, 149 patients with different body mass index were operated. 18 (12.1%) of them are men and 131 (87.9%) are women. The age of the operated patients ranged from 21 to 60 years (average 38.3±5.9 years). 84 (56.3%) of patients suffering from morbid obesity had level III obesity and 65 (43.7%) had level II obesity. 90 (60.4%) patients had one or more co-morbidities, including arterial hypertension 47 (31.5%), gallstone disease 23 (15.2%), diabetes 11 (7.3%)), osteoarthritis 11 (7.3%), diaphragmatic esophageal hernia 7 (4.7%), ischemic heart disease 9 (6.0%). According to the genetic anamnesis of patients with morbid obesity, 46 (30.8%) patients have a genetic predisposition to obesity. In the investigation, it was found that 33 (22.1%) patients received various types of conservative treatment before operative treatment, and in most cases, operative treatment was applied after conservative treatment was ineffective. Metabolic syndrome (MS) was diagnosed in 35 (38%) of the patients

who underwent LLG. Such changes were assessed as complications related to morbid obesity, and these indicators were dynamically observed after the operation[4]. Carbohydrate metabolism-specific tests were performed in obese primary (proposed gastric resection) and control (conventional resection) group patients according to degree of obesity.

It is known that one of the causes of obesity is carbohydrate products. Obesity is often associated with type 2 diabetes. In our study, 3 out of 46 patients included in the main group (6.5%), of which only 3rd degree obesity was observed (11.5%). In the control group, 3 out of 45 patients (6.7%), 2 of them (8%) had 2nd degree obesity, and 1 (4%) had 3rd degree obesity. Taking these into account, we determined the amount of glucose in the blood (see Figure 4.3).

In our study, healthy donors had a blood glucose level of 4.72 ± 0.12 mmol/L, while obese patients tended to increase glucose levels, but these values were around the upper limit of normal values. In patients with diabetes, it was found that the blood glucose level was high, up to 7.1-12.0 mmol/l.

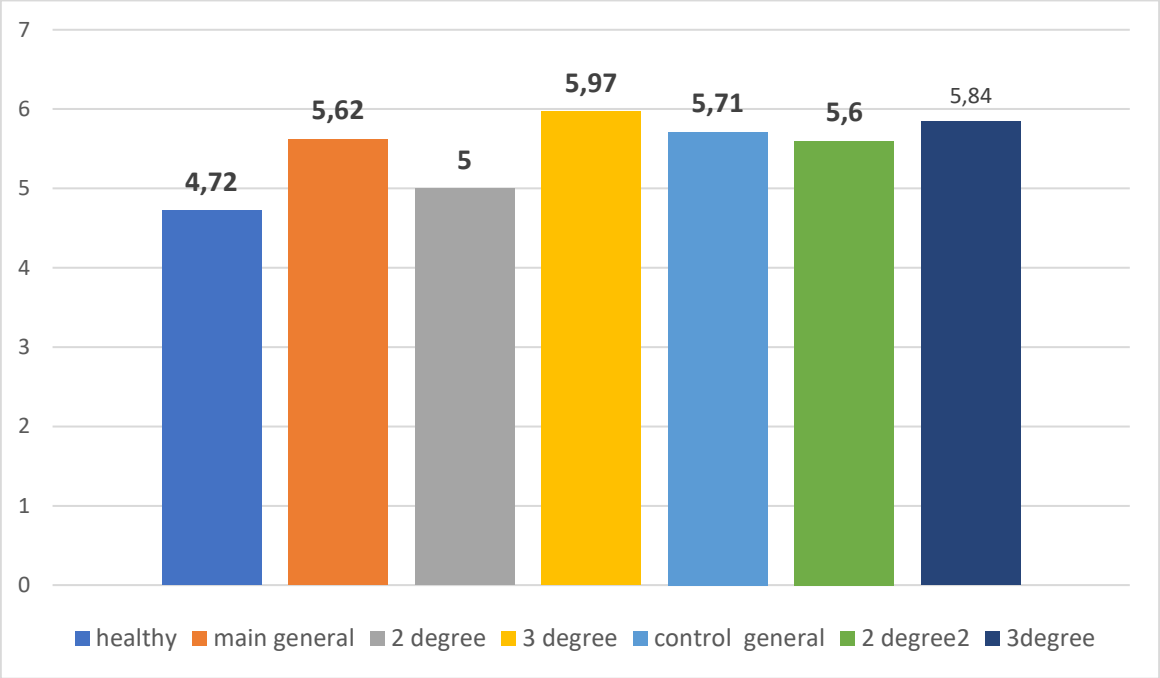
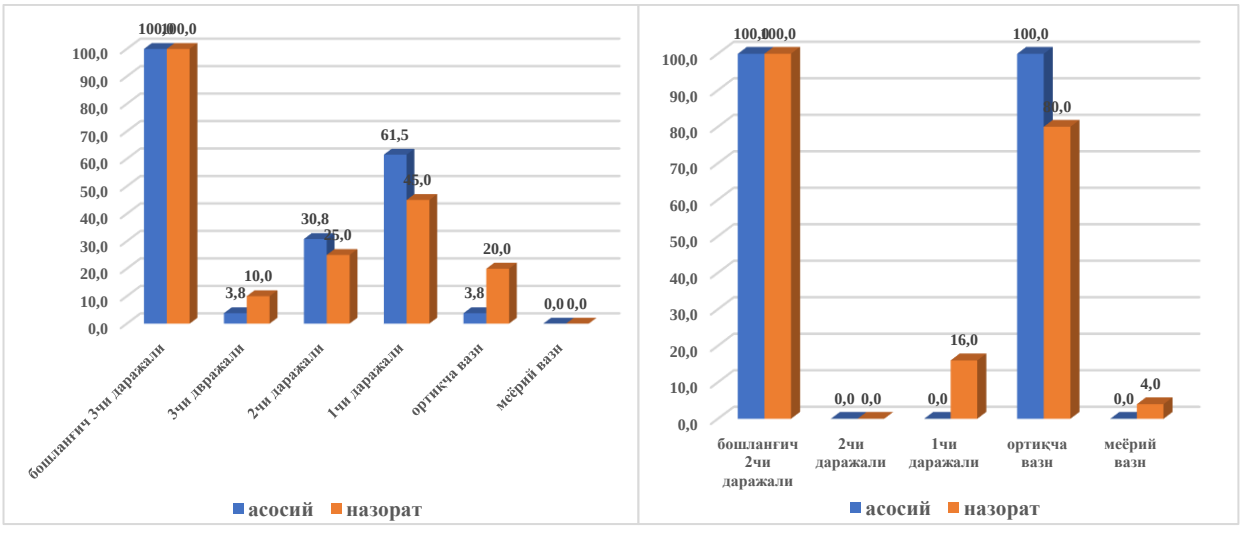


Figure 1. The amount of glucose in the blood serum of patients (mmol/l).

No differences were observed between the main and control groups. In the main group, 3 patients without diabetes were diagnosed with hyperglycemia, 1 of them had obesity of the 2nd degree, and 2 of them had obesity of the 3rd degree. In the control group, 5 patients without diabetes were diagnosed with hyperglycemia, 3 of them had 2nd degree obesity, and 2 had 2nd degree obesity. It is worth saying that the amount of glucose in the blood was to some extent related to the level of obesity.

Correlation analysis of blood glucose levels in BMI(body mass index) patients revealed moderate positive associations (r=0.31, P<0.05 and r=0.33, P<0.05) in both primary and control groups. It is worth saying that 70-80% of patients develop type 2 diabetes due to obesity. The development of metabolic syndrome in such patients is considered insulin resistance and adaptive hyperinsulinemia. However, obesity is important in the origin of insulin resistance, because in such patients it activates several metabolic pathways of the origin of hyperinsulinemia, and hyperglycemia [7]. According to the authors, free fatty acids entering the bloodstream from adipose tissue eliminate the negative effect of insulin on gluconeogenesis and muscles, and reduce the catabolism of this hormone in the liver. At the same time, adipocytes produce many biologically active substances that have a systemic effect on carbohydrate metabolism. In turn, a high concentration of glucose in the blood accelerates inflammatory processes in the endothelium and accelerates the formation of atherosclerotic plaques in blood vessels due to vasoconstriction, increases the autoxidation of glucose and the production of oxygen free radicals, leading to the development of oxidative stress [3]. This requires improvement of treatment procedures and dynamic monitoring after bariatric surgery.

The results obtained. It is known that the effectiveness of bariatric surgery is not observed in the early stages. Therefore, we evaluated the effectiveness of surgical operations after 6 months (see Figure 4.5). The results showed that after 6 months in the main group, all 20 patients with 2nd degree obesity (100%) were overweight, while in the control group 4 out of 25 patients (16%) had 1st degree obesity, 1 (4%) had normal weight and 20 (80 %) overweight was observed.



a b

Figure 2. Treatment efficacy of grade 3 (a) and grade 2 (b) obesity after different types of bariatric surgery.

After surgery in patients with 3rd degree obesity, 1 out of 26 patients (3.8%) in the main group had 3rd degree obesity, 8 (30.8%) had 2nd degree obesity, 17 (65.4%) patients had good positive results. observed, 16 (61.5%) of them had 1st degree obesity and 1 (3.8%) was overweight. Analysis of the results of 20 patients in the control group 6 months after surgery showed that obesity of the 3rd degree remained in 2 (10%) patients, obesity of the 2nd degree was observed in 5 (25%) patients, obesity of the 1st degree was detected in 9 (45%) patients, 4 (20 %) patients were overweight.

The results obtained showed positive results of the proposed bariatric surgery compared to the traditional one. This was especially evident in 2nd degree obesity.

In order to study the effect of bariatric procedures on metabolic processes, we determined the parameters of carbohydrate metabolism again after 6 months.

Surgery in the main and control groups resulted in a 1.23 (P<0.05) and 1.29 (P<0.05) fold decrease in blood glucose after 6 months (see Table 1). This indicator was 1.22 (P<0.05) and 1.29 (P<0.05) times in patients with 2nd degree obesity, 1.38 (P<0.05) and 1.3 (P<0.05) in 3rd degree obesity. <0.05) times decrease was found.

Table 1

Effects of bariatric surgery on serum glucose levels in patients, M±m

Groups	Main group		Control group	
	The beginning	After 6 months	The beginning	After 6 months
Healthy, n=12	4,72±0,12			
Main, n=46	5,62±0,16*	4,26±0,21^	5,56±0,22	4,30±0,05^
2nd degree, n=20	5,08±0,11	4,17±0,03^	5,60±0,25	4,34±0,06^
3rd degree, n=26	5,97±0,25*	4,32±0,05^	5,52±0,39	4,25±0,08^

Note: * - the difference between the indicators of healthy and patients is reliable (R<0.05);
- the difference between pre-treatment and post-treatment values is reliable (R<0.05).

So, bariatric procedures prevent hyperglycemia. In this case, good positive results were observed in the practice of the proposed longitudinal resection of the stomach. When the aforementioned indicators were compared with the results of a meta-analysis, it was observed that a positive change in the carbohydrate profile occurred in patients as a result of various resections of the stomach.

The decrease in stomach volume after surgery in the main and control groups is caused by malabsorption of dietary nutrients. It is important not only to reduce

the efficiency of digestion of nutrients in the stomach, but also to reduce the time of storage of digested mass in the stomach. After all, in this case, the undigested mass in the stomach is transferred to the intestines at a higher frequency, which causes a decrease in the efficiency of the digestive process in the small intestine. In particular, the increase in the volume of fecal excretion in patients who underwent gastric resection by 126% after 6 months and by 87% after 12 months is considered a significant sign of malabsorption induced by gastric resection [14,19]. Also, as a result of the longitudinal resection of the stomach performed in the main group as mentioned above, the loss of the fundal part and the acceleration of the transit of undigested products from the stomach to the intestines lead to a decrease in the production of hormones and peptides released from the gastrointestinal tract [12,21].

In particular, the hormone ghrelin, produced by the fundal part of the stomach, through its orexigenic effect, stimulates the feeling of hunger by affecting the MNT, particularly the hunger centers in the hypothalamus, increases the secretion of gastric juice, enhances gastrointestinal activity, increases the amount of glucose in the blood, and the correct proportionality between its production and the size of the stomach. there is a correlation [12,18,21]. In addition, YY peptide is an orexigenic peptide produced by pancreatic and enteroendocrine cells, expressed as YY1-36 peptide and converted to YY3-36 by dipeptidyl peptidase-IV enzyme in the blood. Thus, it creates a strong affinity for the neuropeptide Y-2 receptor in MNT [20]. Peptide YY3-36 induces effects such as delaying the transit of food from the stomach to the intestines, reducing postprandial insulin production, altering colonic motility, and regulating appetite [17]. Therefore, gastric resection accelerates the passage of food mass from the stomach to the intestines by reducing the production of YY1-36 peptide in the intestines, reduces appetite and causes a decrease in blood glucose [11].

Similarly, glucagon-like peptide-1 hormone is produced mainly by enteroendocrine L-cells of the intestine, ileum, colon and some neurons in the nucleus of the central nervous system. GLP-1 is an important regulatory hormone in the metabolism of the body and has an active anorexigenic effect on hypothalamic centers and can reduce food intake [15]. In addition, GLP-1 can also activate vagus afferent neurons and has a synergistic effect on insulin by lowering blood glucose [13]. The gastric resection procedure has a positive effect on GLP-1 production from the jejunum and ileum, and therefore GLP-1 analogs are used as effective anti-obesity drugs [15,22].

Thus, compared to the initial biochemical results of patients in the main and control group after surgery, there was a statistically reliable change in glucose

concentration indicators. Interestingly, in the main group compared to the control group, a dynamic change in the plasma glucose concentration indicators was observed, a higher positive change than that of the control group, on the other hand, from the indicators presented in the control group, no statistically significant change was detected compared to the main group.

The mentioned results indicate that the treatment efficiency is relatively high in the main group and that the normalization of glucose concentration in patients after longitudinal resection of the stomach is relatively high and reliably more effective. This is due to the fact that as a result of gastric longitudinal resection, patients not only experience malabsorption, but also decrease the production of orexigenic and hyperglycemia-inducing peptides and increase the production of some anorexigenic and insulin-sensitizing peptides, physical and psychological limitation of alimentary nutrient absorption, and normalization of lipid and carbohydrate metabolism. related to the occurrence of effects. After all, by reducing lipid absorption and increasing sensitivity to insulin, the level of triglycerides in the blood decreases, and its amount increases by slowing down the catabolism of ZYuLP, on the other hand, the concentration of ZLPP decreases due to the increase in its catabolism and the decrease in its production from the liver.

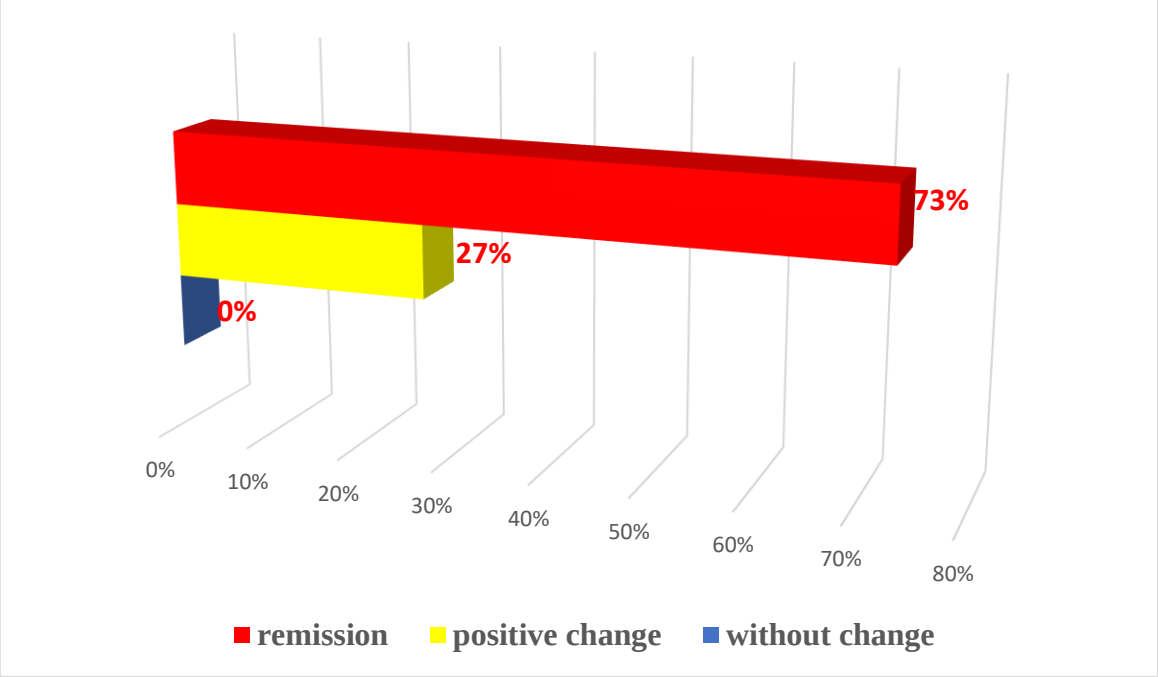


Figure 3. The course of type 2 diabetes mellitus after a longitudinal resection of the stomach

As a result, there was a tendency to develop hyperglycemia in the blood serum of obese patients, and the amount of glucose was in the upper limit of normal values. In the main group, 3 patients without diabetes were diagnosed with hyperglycemia, 1 of them had obesity of the 2nd degree, and 2 of them had obesity

of the 3rd degree. In the control group, 5 patients without diabetes were diagnosed with hyperglycemia, 3 of them had 2nd degree obesity, and 2 had 2nd degree obesity. Also, among 11 patients diagnosed with type 2 diabetes in our observation groups, clinical improvement of disease symptoms was observed in 3(27%) patients, and complete remission was observed in 8(73%) patients after OBR practice. It is noteworthy that there were no patients whose clinical course of the disease remained unchanged after the operation.

Summing up from the above, it was observed that the practice of OBR is an effective type of practice not only in the presence of obesity, but also in the presence of obesity with metabolic syndrome.

Conclusions

Improvement of carbohydrate metabolism as a result of gastric longitudinal resection in patients not only causes malabsorption, but also decreases the production of peptides with orexigenic and hyperglycemia-inducing effects, as well as increases the production of some anorexigenic and tissue insulin-sensitizing peptides, restricts the absorption of alimentary nutrients (physically and psychologically) and normalizes carbohydrate metabolism. related to the effect.

As a result of the corrective effect of gastric longitudinal resection on existing metabolic indicators in patients suffering from morbid obesity, it improves the course of patients in the early period and concomitant diseases, and has a positive effect on the clinical course of not only prediabetes, but also diabetes. Longitudinal resection of the stomach can be used as the first stage of the operation in patients with severe metabolic disorders and diabetes, when there is a high anesthesiological risk of gastric bypass surgery.

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