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Study of Lipid Metabolism Disorders in Patients with Morbid Obesity and Evaluation of the Corrective Effect of Laparoscopic Sleeve Gastrectomy on These Changes

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Abstract:

Goals: To study the evaluation of lipid metabolism after the operation of sleeve resection in patients with morbid obesity. Materials and Methods: From 2019 to 2022, 277 bariatric and metabolic surgeries were performed in our clinical sites, including 125 MGSH and 152 PRG. Results: In our clinic, we studied the effect of sleeve resection practice on lipid metabolism before surgery and in the long term 6 months after surgery. The frequency of occurrence of the studied types of dyslipidemia depended on the degree of obesity. The frequency of the studied types of dyslipidemia depended on the degree of obesity. Hypercholesterolemia persisted in 4 (8.9%) patients after traditional sleeve resection, and after the proposed method of sleeve resection, this indicator in all patients did not differ from the normative indicators. The proposed surgical procedure leads to a decrease in the coefficient of atherogenicity and prevents dyslipoproteinemia.

Conclusion: After 6 months of bariatric surgery, a statistically significant decrease in the level of UAG in serum blood was observed in the primary and control group of patients, which testifies to the greater effectiveness of the proposed operative intervention compared to the control group and the ratio of complete liquidation of hypertriglyceridemia.

Keywords: *morbid obesity, bariatric surgery, metabolic syndrome, laparoscopic sleeve gastrectomy, staple line, suture instability.*

1. Introduction.

Obesity is a chronic metabolic disease, characterized by excessive development of adipose tissue, it is understood as a pathological condition with a certain number of complications and a high probability of recurrence after the end of treatment[7,19].

The prevalence of obesity in the last twenty years has reached the level of a global pandemic, has made it one of the main issues and directions of the activities of all world public health organizations and is treated as a civilization disease, with huge socioeconomic and psychosocial importance [7,22,27]. Obesity, the core component of metabolic syndrome, is often accompanied by insulin resistance, hyperglycemia, hyperlipidemia and hypertension [1,14,39.]

Morbid obesity is the presence of severe obesity-related complications when TMI is ≥40 kg/m^2 or TMI is ≥35 kg/m^2. Morbid obesity is a serious medical and social problem associated with a decrease in the quality of life and its duration. According to WHO data, among adults, 1.6-1.9 billion people are overweight[17,30].

Lifestyle changes contribute significantly to the increase in the prevalence of obesity worldwide. Obesity affects children, adolescents and adults and is accompanied by comorbidities such as hypertension, dyslipidemia, type 2 diabetes, cancer, osteoarthritis and sleep apnea **[**40,21,28**]**.

An analysis of the treatment methods for morbid obesity shows that bariatric surgery is currently the only effective option to achieve long-term stable weight loss for this patient population [47].

Among the various bariatric surgeries available, laparoscopic sleeve gastrectomy (LSG) has shown advantages over other bariatric procedures and is currently one of the most common bariatric surgeries worldwide. Compared to other bariatric surgeries, laparoscopic sleeve gastrectomy (LSG) is a technically simpler procedure that results in fewer changes to the normal anatomy and physiology of the gastrointestinal tract. Recently, its popularity has increased due to its proven effectiveness in achieving significant weight loss and resolution of comorbidities without increasing the risk of complications [34,41].

Laparoscopic sleeve gastrectomy (LSG) of the stomach is an important bariatric operation used in the treatment of patients with morbid obesity [13,43].

According to Buchwald and Oien [8] published in a meta-analysis, LSG is the second most important bariatric surgery in the world, behind only LRYGB. In addition, LSG has surpassed LRYGB as the most frequently performed bariatric procedure in American academic centers [15].

LSG represented the most frequently performed bariatric procedure in the U.S. in 2017, with rates of bariatric surgery as follows: 59.4% SG, 17.8% Roux-en Y Gastric Bypass (RYGB), 2.8% Laparoscopic Adjustable Gastric Banding (LAGB) and 0.7% Biliopancreatic Diversion with Duodenal Switch (BPD-DS) [16].

In addition to being a restrictive procedure, sleeve gastrectomy is hypothesized to reduce the hormone ghrelin, which increases hunger [6,29].

The prevalence of this syndrome among the world's population is increasing and reaching levels that make it possible to treat it as a problem and a disease that threatens public health and even civilization [27].

Conducted long-term scientific studies on the problem of morbid obesity have revealed its etiological and pathogenetic relationship with many common diseases, such as cardiovascular diseases, including atherosclerosis, hypertension, insulin-dependent diabetes, dyslipidemia, obstructive sleep apnea syndrome, bone and joint diseases, depression, some types of cancer, diseases of the reproductive system, etc. [12,33].

It has been proven that morbid obesity and metabolic syndrome are the main factor contributing to the development of cardiovascular diseases, increasing the risk of myocardial infarction by 2.5 -fold, causing a 1.5-fold increase in overall mortality and a 2-fold increase in the incidence of all cardiovascular diseases, including cerebral stroke [23].

Lipid metabolism disorders are one of the main pathological disorders coexisting with morbid obesity and metabolic syndrome. Patients with abdominal obesity are more susceptible to atherogenic dyslipidemia, which is associated with an increased risk of cardiovascular disease with atherosclerotic disease and an increased risk of morbidity and mortality due to cardiovascular disease [35]

A systematic review and meta-analysis in the literature to examine the efficacy and possible risks of bariatric surgery showed that only a few studies have examined the outcome of dyslipidaemia. More than two-thirds of the patients included in these studies showed remission of dyslipidemia after surgery [24,10,36].

Obese individuals undergoing bariatric surgery have improved cardiometabolic outcomes and retrospective studies have demonstrated a reduced risk of mortality [2,18].

A study has shown that serum fatty acid levels, which may influence inflammation and LDL oxidation, are a factor that may explain the reduction in cardiometabolic risk after bariatric surgery [26]. After bariatric surgery, replacing saturated fatty acids (SFA) with polyunsaturated fatty acids (PUFA) in the diet reduces the risk of coronary heart disease [31,45].

Considering the lack of knowledge of lipid metabolism after the operation of a longitudinal resection of the stomach, our goal was to study the lipid profile in dynamics.

2. Materials and methods:

From 2019 to 2022, 231 metabolic and bariatric surgeries were performed in our clinic, of which 82 were minigastroshunt (MGS) and 149 were laparoscopic sleeve gastrectomy (LSG). In recent years, the number of patients with morbid obesity has increased, and the scope of LSG 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%) of the patients had one or more concurrent comorbidities, including arterial hypertension 47 (31.5%), gallstone disease 23 (15.2%), diabetes 11 (7%)[42].

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 SR. Such changes were assessed as complications related to morbid obesity, and these indicators were dynamically observed after the operation

It is known that dyslipidemia is the main biochemical marker of morbid obesity. After all, lipid metabolism is related to its location, fat accumulation in the visceral part of the body, high amount of triacylglycerides (UAG) and low concentration of cholesterol in high density lipoproteins are interrelated[9,20,25]. By understanding the mechanism of development of dyslipidemia in morbid obesity, it helps to determine the importance of these markers in evaluating the effectiveness of gastric resection. It is known that in morbid obesity, high amounts of UAG activate the production of large amounts of low-density lipoproteins (LDLP) from the liver[4,48]. As a result of insulin resistance developed or as a result of obesity, high levels of insulin inhibit the process of lipolysis in adipose tissue and lead to the preservation of UAG and LDLP in high concentrations by increasing lipogenesis. In addition, according to the results of some studies, the synthesis and secretion of chylomicrons is increased in obese patients, which is probably related to high dietary lipid intake[5,11].

Normally, the enzyme lipoprotein lipase hydrolyzes triglycerides in chylomicrons and VLDLP (very low-density lipoprotein), thereby accelerating their breakdown by shrinking chylomicrons and VLDLP. However, as a result of insulin resistance developed due to obesity, the activity of lipoprotein lipase decreases, which causes disruption of the normal catabolism of chylomicrons and VLDLP. In the case of obesity, the release of many fatty acids from adipocytes induces their accumulation in the liver[46].

Normally, through continuous transport of UAGs from LDLPs to VLDLP (via CETP - cholesterol ester transport protein), UAG-rich VLDLP is considered a favorable target for liver lipase and its catabolism is accelerated. In the case of obesity, the accumulation of many UAGs in VLDLP, as well as the increased expression of liver lipase, causes the acceleration of VLDLP catabolism, thereby reducing its plasma concentration[37,38,44]. In addition, the main cells that express CETP are adipocytes, and its expression increases in obesity and induces the acceleration of VLDLP catabolism[3]. In the case of obesity, VLDLP changes not only in terms of quantity, but also in terms of quality. In particular, the decrease in the expression of ABCA1 protein, which ensures the transport of cholesterol in adipocytes, in the state of obesity [48].

Biochemical tests, in particular lipid and carbohydrate metabolism tests, were performed according to the degree of obesity in the main (proposed gastric resection) and control (conventional resection) group patients with obesity. The research conducted showed that the amount of UAG in the blood serum of the main and control group patients was 1.7 ($P<0.01$) and 1.75 ($P<0.01$) times higher than the standard values, 1.82±0.05 and 1.87± increased to 0.11 mmol/l, in healthy donors this indicator was 1.07±0.04 mmol/l (Fig. 1). It is worth saying that the change in the amount of UAGs in the blood serum of patients was directly related to the level of obesity. In particular, if 2nd degree obesity was observed in the main and control group, the amount of UAG increased by 1.54 (P<0.01) times and reached 1.65±0.07 mmol/L.

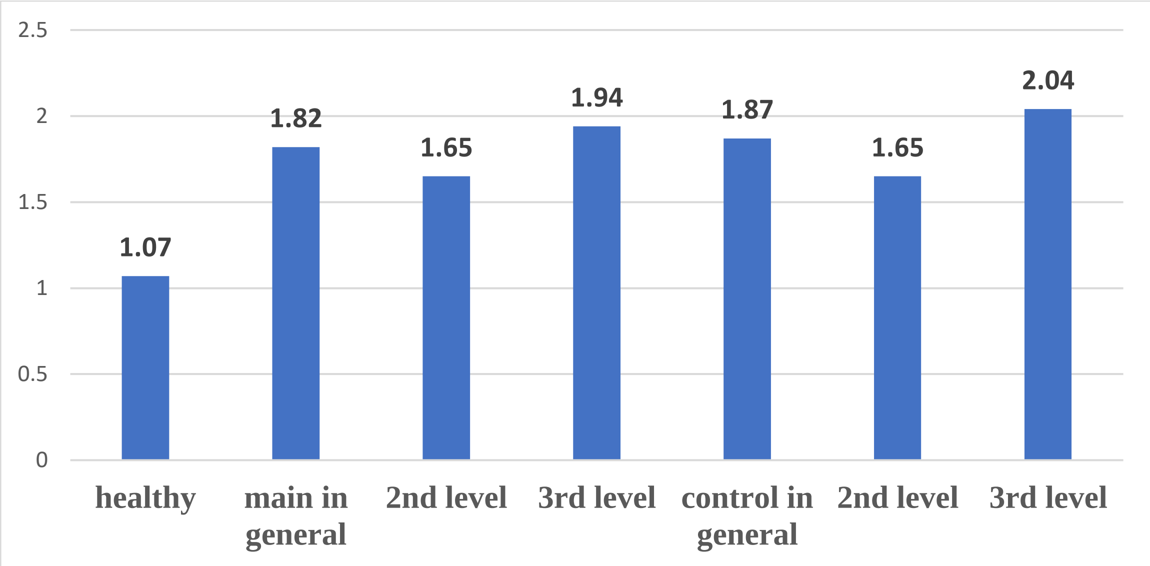

Figure 1. The amount of triacylglycerides in the blood serum of patients (mmol/l).

In patients with genetic predisposition, the amount of UAG in blood serum was higher. In particular, in 21 (46.7%) of 45 patients with 2nd degree obesity, the amount of UAG was around 2-2.50 mmol/l, while it was up to 2.0 mmol/l in non-obese patients. In 43 (93.5%) of 46 patients with 3rd degree obesity, the amount of UAG was around 2.50-3.20 mmol/l, while in non-obese patients it was up to 2.0 mmol/l. At the same time, the amount of UAG was higher in patients with comorbid diseases of arterial hypertension and diabetes.

Thus, dyslipidemia in abdominal-visceral obesity is associated with the acceleration of UAG synthesis from free fatty acids that come to the liver in large quantities.

At the same time, cholesterol metabolism disorders were also found in such patients (see Table 4.1). In particular, the total amount of XS in the blood serum of the main and control groups was 1.26 (P<0.05) and 1.28 (P<0.05) times higher than the norm. This indicator also depends on the level of obesity, and its amount is 1.15 (P<0.05) and 1.25 (P<0.05) times higher in patients with primary and control 2nd degree obesity, and 1.34 in 3rd degree obesity. (P<0.05) and 1.31 (P<0.05) times higher than the standard values.

According to these obtained results, the amount of XS in LDLP also increased (Table 1). In particular, the amount of XS in LDLPs in the blood serum of the main and control groups was 1.56 (P<0.01) and 1.40 (P<0.01) times higher than the normal values. This indicator also depends on the degree of obesity, and its amount is 1.25 (P<0.05) and 1.30 (P<0.05) times higher in patients with primary and control 2nd degree obesity, and 1.38 in 3rd degree obesity. (P<0.05) and 1.25 (P<0.05) times lower than the standard values.

Cholesterol metabolism parameters in the blood serum of the main and control groups of patients with different degrees of obesity, M±m

Table 1

Groups	Total XS, mmol/l	VLDLP XS, mmol/l	LDLP XS, mmol/l	Atherogenic coefficient
Healthy, n=12	3.91±0.05	1.46±0.03	2.12±0.06	1.68±0.06
Main, n=46	4.92±0.08*	1.08±0.03*	3.31±0.19*	3.19±0.18*

Level 2, n=20	4.48±0.03*	1.12±0.05*	2.66±0.16*	3.05±0.22*
Level 3, n=26	5.22±0.10*	1.06±0.05*	3.01±0.17*	3.60±0.31*
Check point, n=45	5.00±0.10*	1.20±0.04*	2.97±0.13*	3.42±0.16*
Level 2, n=25	4.90±0.12*	1.22±0.07*	2.75±0.11*	3.36±0.22*
Level 3, n=20	5.12±0.16*	1.17±0.05*	3.03±0.22*	3.33±0.23*

Note: *- the difference between healthy and patient indicators is reliable (R<0.05).

At the same time, we observed that the amount of XS in VLDLPs decreased by 1.35 (P<0.05) and 1.22 (P<0.05) times in the blood serum of patients with obesity in the main and control groups. This indicator also depends on the level of obesity, and in the main and control patients with 2nd degree obesity, its amount decreased by 1.30 (P<0.05) and 1.20 (P<0.05) times, while in 3rd degree obesity - 1.34 (P<0.05) and 1.31 (P<0.05) times higher than the standard values.

Such a change in cholesterol carrier forms led to an increase in the atherogenic coefficient (AK) in patients. In particular, in the main and control group patients, AK was 1.90 (P<0.001) and 2.04 (P<0.001) times higher than the norm. This indicator also depends on the level of obesity, and its amount is 1.81 (P<0.001) and 2 (P<0.001) times higher in the main and control patients with 2nd degree obesity, and 2.14 (P<0.001) and 2.14 (P<0.001) in 3rd degree obesity. It was 1.98 (P<0.001) times higher than the norm.

In order to determine the association of serum lipid parameters with TMI, we analyzed correlational associations. The obtained results revealed negative medium correlations (r=-0.4, P<0.05 and r=-0.34, P<0.05) between the amount of XS in VLDLPs and TMI in the main and control groups, while the mean correlation with the amount of XS in LDLPs was positive (r=0.31, P<0.05 and r=0.37, P<0.05). Moderately positive correlations in this pattern were atherogenicity coefficient (r=0.35, P<0.05 and r=0.36, P<0.05) and amount of UAGs (r=0.34, P<0.05 and r= 0.39, P<0.05).

Thus, in our study, in patients with abdominal-visceral obesity, dyslipidemia was manifested by an increase in UAG, total XS, cholesterol in LDLPs, a decrease in XS in LDLPs, and a sharp increase in AK. In our opinion, the dyslipidemia observed in obesity is defined by the combination of 3 main criteria:

hypertriglyceridemia, a decrease in the amount of XS in VLDLPs and an increase in the amount of XS in LDLPs.

The presence of this complex in patients increases the risk of vascular system catastrophes and the development of heart diseases 35 times.

The mechanism of development of dyslipidemia in obesity is associated with an increase in the amount of UAGs due to a decrease in the breakdown of lipoproteins due to a change in the activity of lipoprotein lipase and liver triglyceride lipase. Such changes lead to an increase in UAGs in high and low density lipoproteins and an increase in small dense products in LDLPs. An increase in the amount of remnant chylomicrons and UAGs in the blood causes a decrease in the synthesis of apolipoprotein A1 and a decrease in the amount of antiatherogenic VLDLPs. A large influx of free fatty acids into the liver leads to an acceleration of the synthesis of UAG, very low density lipoproteins and apolipoprotein V.

Taking this into account, we determined the level of occurrence of dyslipoproteinemia types (isolated hypoalphacholesterolemia, IIb type of dyslipidemia, IV type of dyslipidemia) in patients participating in the study (Fig. 2). The analysis showed that isolated hypoalphacholesterolemia occurred in 15.8 and 8.9% of patients in the main and control groups, IIb type of dyslipidemia - 39.5 and 46.7%, and type IV dyslipidemia - in 28.9 and 31.1% of the main and control groups. found in group patients.

It is worth saying that such changes depended to some extent on the level of obesity. In particular, isolated hypoalphacholesterolemia was found in 10 and 8% of patients with 2nd degree of obesity, type IIb of dyslipidemia was found in 25 and 36%, and type IV of dyslipidemia was found in 30 and 32% of patients of the

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main and control groups. In patients with 3rd degree obesity, isolated hypoalphacholesterolemia was found in 16.7 and 10% of patients, type IIb of dyslipidemia was found in 55.5 and 60%, and type IV of dyslipidemia was found in 27.8 and 35% of patients of the main and control groups.

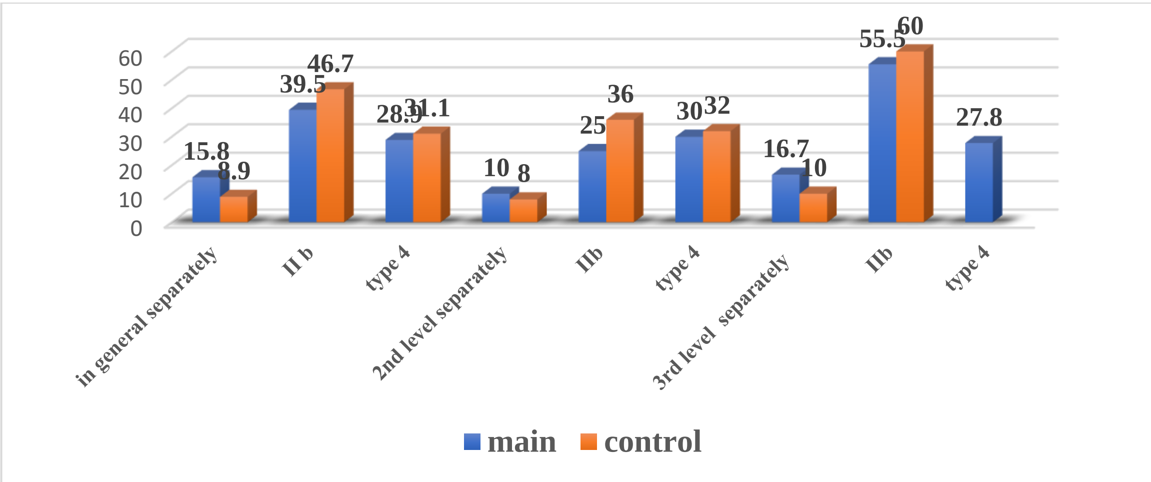

Figure 2. Frequency of meeting types of dyslipoproteinemia in patients (%).

The obtained results indicate that atherogenic conditions are also observed in patients suffering from obesity, which requires the elimination of identified dyslipidemias to increase the effectiveness of obesity treatment.

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 (Fig. 3).

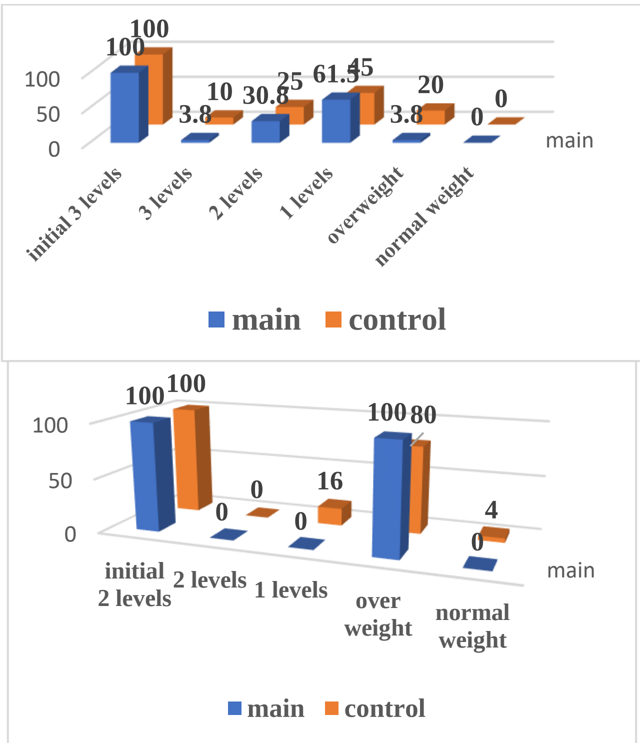

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Figure 3. Treatment efficacy of grade 3 (a) and grade 2 (b) obesity after different types of bariatric surgery.

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.

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, after 6 months we again determined blood lipid parameters. In particular, the amount of UAG in the blood serum of the main and control group patients 6 months after surgery was 2.14($P<0.001$)and 1.56($P<0.05$)was found to decrease several times (table 2). In this case, the amount of UAG in patients with obesity of the 2nd degree is 2.14($P<0.001$)and 1.51($P<0.05$)2.02 in 3rd degree obesity($P<0.001$)and 1.59($P<0.01$)a decrease was observed. It is worth noting that the proposed surgical procedure reduced the serum UAG levels of patients with 2nd and 3rd degree obesity by 1.42 compared to the control group.($P<0.05$)and 1.27($P<0.05$)led to a stronger decline.

Effects of bariatric surgery on serum triglycerides and cholesterol levels in patients, M±m

Table 2

Groups	UAG, mmol/l		Total XS, mmol/l	
	initial	After 6 months	initial	After 6 months
Healthy, n=12	1.07±0.04		3.91±0.05	
Main, n=46	1.82±0.05*	0.85±0.04*^	4.92±0.08*	3.98±0.03^
Level 2, n=20	1.65±0.07*	0.77±0.05*^	4.48±0.03*	3.85±0.02^
Level 3, n=26	1.94±0.05*	0.96±0.08^	5.22±0.10*	4.30±0.07*^
Check point, n=45	1.87±0.11*	1.20±0.06^	5.00±0.10*	4.25±0.11*^
Level 2, n=25	1.65±0.07*	1.09±0.08^	4.90±0.12*	4.19±0.14^
Level 3, n=20	2.04±0.16*	1.28±0.08^	5.12±0.16*	4.32±0.18*^

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

Total cholesterol in the blood serum of the main and control group patients 6 months after surgery was 1.24($P<0.05$)and 1.18($P<0.05$)was found to decrease several times. In this case, total cholesterol in patients with 2nd degree of obesity is 1.16($P<0.05$)and 1.17($P<0.05$)1.21 in 3rd degree obesity($P<0.05$)and 1.18($P<0.05$)a decrease was observed. It is worth noting that the proposed and conventional bariatric procedures had approximately the same effect on patients' serum total cholesterol. It is worth saying that if hypercholesterolemia remained in 4 (8.9%) patients after traditional bariatric, this indicator did not differ from the norm in all patients after the proposed method.

Conventional bariatric practice did not significantly affect the amount of XS in serum VLDLPs, although the proposed practice after 6 months was 1.47($P<0.05$)times led to an increase in this indicator (Table 3). Similar changes were also observed in patients with 2nd degree of obesity, that is, if a tendency to increase the low amount of XS in VLDLPs was observed in the blood of the control group patients, this indicator was 1.41 in the blood serum of the patients in the main group.(P<0.05)times raised. This indicator is 1.20 in patients with 3rd degree obesity of the main and control groups(P<0.05)and 1.50(P<0.05)times increased.

It should be noted that the proposed modification of the LSG operation led to a statistically significant increase in total cholesterol in the blood serum in patients with all degrees of obesity compared with the control [32].

Effect of bariatric surgery on parameters of cholesterol transport forms in blood serum of patients, M±m

Table 3

Groups	VLDLP XS, mmol/l		LDLP XS, mmol/l	
	initial	After 6 months	initial	After 6 months
Healthy, n=12	1.46±0.03		2.12±0.06	
Main, n=46	1.08±0.03*	1.59±0.02^	3.31±0.19*	1.57±0.08^
Level 2, n=20	1.12±0.05*	1.58±0.02^	2.66±0.16*	1.55±0.11^
Level 3, n=26	1.06±0.05*	1.59±0.03^	3.01±0.17*	1.66±0.10^
Check point, n=45	1.20±0.04*	1.34±0.02	2.97±0.13*	2.33±0.11
Level 2, n=25	1.22±0.07*	1.29±0.03	2.75±0.11*	2.34±0.14
Level 3, n=20	1.17±0.05*	1.40±0.02^	3.03±0.22*	2.32±0.17^

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

Carrying out bariatric procedures in the traditional way showed a tendency to decrease the high concentration of XS in LDLPs in the blood serum of patients with 2nd degree obesity, while in 3rd degree obesity we found it statistically reliable 1.31(P<0.05)times decreased. Recommended bariatric treatment in the blood serum of patients with 2nd and 3rd degree obesity is 1.72(P<0.01)and 1.81(P<0.01)led to a decrease in times. It is worth saying that the proposed surgical procedure in the blood serum of patients.(P<0.05)2.11 after the recommended practice if it has reduced the number of times(P<0.001)times, that is, the difference between the main and control groups is 1.66(P<0.01)organized. It should be noted that hypoalphaproteinemia was not observed after treatment in either the primary or control groups, while hyper-β-lipoproteinemia was not observed in the primary group, while it persisted in 4 (8.9%) patients in the control group.

As we noted above, the atherogenic index was higher in obese patients. After different types of bariatric surgery, this ratio decreased by 2.47 (P<0.001) and 1.47 (P<0.05) times in the main and control groups, and 1.29±0.06 and 2.33±0.11 organized. If its indicator decreased by 2.34 (P<0.001) and 1.44 (P<0.05) times to 1.30±0.08 and 2.34±0.14 in patients with 2nd degree obesity, then in 3rd degree obesity this decrease decreased by 2.8 (P<0.001) and 1.43 (P<0.05) times, and was 1.29±0.08 and 2.32±0.17 (Fig. 4).

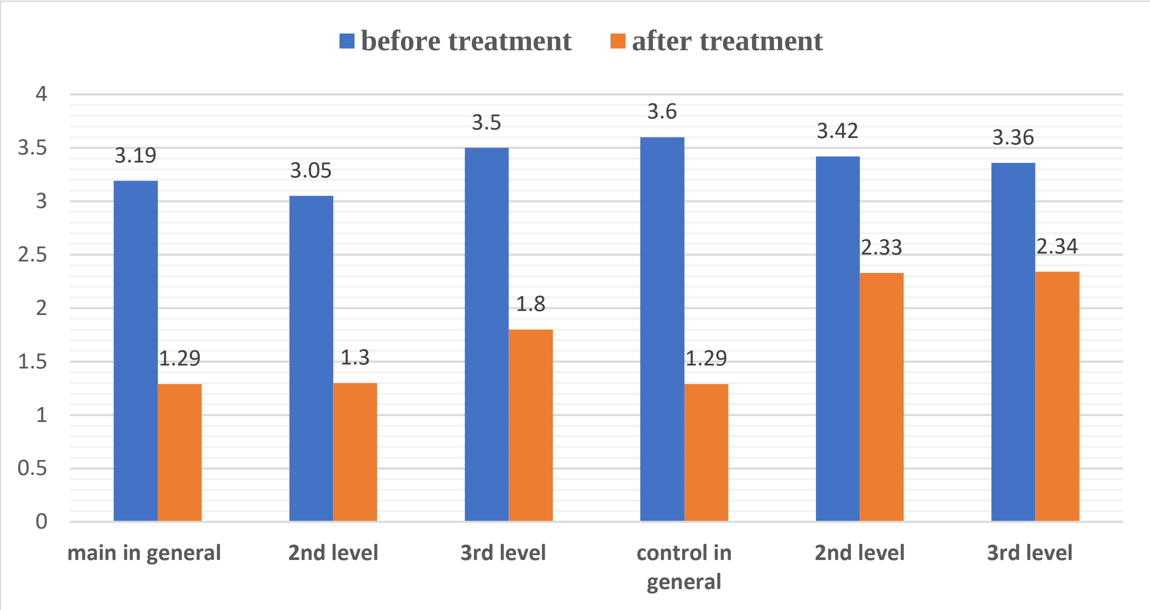

Figure 4. Effect of different bariatric surgery procedures on atherogenicity coefficient.

It is worth saying that if in the main group the coefficient of atherogenicity does not differ much from the normative indicators, in the control group they are a statistically reliable general group, in the 2nd and 3rd degree of obesity it is 1.37($P<0.05$); 1.39 ($P<0.05$) and 1.38 ($P<0.05$) times remained high. 1.80 ($P<0.001$) compared to the main group indicators; 1.81 ($P<0.001$) and 1.80 ($P<0.001$) times higher.

Therefore, the proposed surgical procedure leads to a decrease in the coefficient of atherogenicity and prevents dyslipoproteinemia. This is evidenced by hypo-a-lipoproteinemia in the main group of patients,type IIb dyslipidemia and type IV dyslipidemia were not detected in the control grouphypo-a-lipoproteinemiawas not detected, type IIb of dyslipidemia remained in 8.9%, and type IV of dyslipidemia remained in 2.2% of patients.

Thus, a statistically reliable change in lipid profile and glucose concentration indicators was observed in patients of the main and control group after the surgical operation, compared to the initial biochemical results. Interestingly, in the main group compared to the control group, there was a positive change in the dynamic change of VLDLP, atherogenic coefficient and plasma glucose concentration indicators, higher 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 above results indicate that the treatment efficiency in the main group is relatively high and the normalization of lipid profile and glucose concentration in patients after longitudinal gastric resection 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, through reduced absorption of alimentary lipids and increased sensitivity to insulin,

The results obtained in this way show that hypertriglyceridemia develops in the blood serum of obese patients and its sharp changes are directly related to the level of obesity. The amount of UAG in blood serum was higher in patients with genetic predisposition, arterial hypertension, diabetes comorbid diseases. In our opinion, the mechanism of development of hypertriglyceridemia in abdominal-visceral obesity may be related to the acceleration of UAG synthesis from free fatty acids that come to the liver in large quantities. At the same time, the development of hypercholesterolemia, hyper-β-lipoproteinemia and hypo-α-lipoproteinemia was described in such patients, and their changes were directly related to the degree of obesity. Such changes in serum lipid parameters in the main and control groups, if isolated hypoalphacholesterolemia occurred in 15.8 and 8.9% of patients, type IIb of dyslipidemia - 39.5 and 46.7%, and type IV of dyslipidemia - 28.9 and 31, observed in 1% of patients. The frequency of occurrence of the mentioned types of dyslipidemia depended on the degree of obesity. In order to determine the association of serum lipid parameters with TMI, we analyzed correlational associations. The obtained results revealed negative medium correlations between the amount of XS in VLDLPs and TMI in the main and control groups. Triacylglycerides, total cholesterol, XS content in LDLPs and glucose were moderately positive. The obtained results indicate that such patients have a tendency to diseases of the cardiovascular system.

After 6 months of bariatric procedures, a statistically significant decrease in the amount of UAG in the blood serum of the main and control group patients was found, indicating that the proposed surgery was effective in completely eliminating hypertriglyceridemia compared to the control group. Total cholesterol after surgery in the serum of the main and control group patients, because if hypercholesterolemia remained in 4 (8.9%) patients after traditional bariatric surgery, this indicator did not differ from the norm in all patients after the proposed method. Similar positive changes were observed in LDLPs. Conventional bariatric practice did not significantly affect the amount of XS in serum VLDLPs, although the proposed practice after 6 months was 1.47($P<0.05$)caused this indicator to rise several times. The proposed surgery resulted in a statistically significant increase in total cholesterol in the serum of the patients compared to the control group at all levels of obesity.Therefore, the proposed surgical procedure leads to a decrease in the coefficient of atherogenicity and prevents dyslipoproteinemia. This is evidenced by hypo-a-lipoproteinemia in the main group of patients,type IIb dyslipidemia and type IV dyslipidemia were not detected in the control grouphypo-a-lipoproteinemiawas not detected, type IIb of dyslipidemia remained in 8.9%, and type IV of dyslipidemia remained in 2.2% of patients.

3. Conclusions:

1. In obesity, depending on its severity, a statistically significant increase in the amount of triglycerides in the blood serum of patients was observed, and a moderate positive association with TMI was found; It was even higher in patients with hereditary predisposition, arterial hypertension and diabetes mellitus.
2. In obesity, depending on its severity, the total cholesterol in the blood serum of patients, the amount of cholesterol in LDLPs is statistically convincingly high, and it was found that the amount of cholesterol in VLDLPs is reduced. A moderate positive correlation was found between TMI and total cholesterol and the amount of cholesterol in LDLPs, while an average negative correlation was found with the amount of cholesterol in VLDLPs. In the main and control groups, isolated hypoalphacholesterolemia occurred in 15.8 and 8.9% of patients, IIb type of dyslipidemia - 39.5 and 46.7%, and IV type of dyslipidemia - in 28.9 and 31.1% of patients in the main and control groups. met Such changes depend on the level of obesity, hypoalphacholesterolemia in 2nd and 3rd degree obesity is 9 and 13.3%, type IIb dyslipidemia is 30.5 and 57.75%, and type IV dyslipidemia is 28,
3. After 6 months of bariatric procedures, total cholesterol, cholesterol in LDLPs, atherogenic coefficient, and especially triglycerides decreased, cholesterol increased in VLDLPs, and such positive changes were clearly identified in the main group of patients. If following the proposed methodhypo-a-lipoproteinemia,type IIb dyslipidemia and type IV dyslipidemia were not detected in the control grouphypo-a-lipoproteinemiawas not detected, type IIb of dyslipidemia remained in 8.9%, and type IV of dyslipidemia remained in 2.2% of patients.

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