American Journal of Interdisciplinary Research and Development
ISSN Online: 2771-8948
Website: www.ajird.journalspark.org
Volume 35, December - 2024

THE INFLUENCE OF SLEEVE GASTRECTOMY ON HEMOSTASIS IN PATIENTS WITH MORBID OBESITY

A. S. Murodov
O. R. Teshaev
A. R. Mavlyanov
Tashkent Medical Academy

Abstract
Evaluation of hemostasis disorders in patients with morbid obesity and study of the significance of the practice of longitudinal resection of the stomach. From 2019 to 2022 years in our clinic were performed 231 metabolic and bariatric surgeries, including 82 minigastric bypasses (MGS) and 149 sleeve gastrectomy (SG). Over the years, SG was performed in 149 patients with different body mass index. 84 (56,3%) patients suffering from morbid obesity had grade III obesity, 65 (43,7%) had grade II obesity. The analyzes performed showed that patients suffering from morbid obesity have a tendency to hypercoagulability in vascular-platelet and coagulation hemostasis.
In morbid obesity, depending on its severity, statistically significant disturbances in the value of hemostasis parameters of patients were observed, a moderate positive association with BMI was revealed; genetic predisposition, as well as in patients with concomitant diseases such as diabetes mellitus.

Keywords: Bariatric surgery, morbid obesity, hemostasis parameters, sleeve gastrectomy.

Introduction

Obesity is a chronic metabolic disease, manifested by excessive development of adipose tissue, progressing in its natural course, having a certain range of complications and having a high probability of relapse after completion of treatment [2]. At the turn of the 20th and 21st centuries, obesity was rightfully described as a non-infectious epidemic by WHO. The disease depends on the interaction of several factors, such as genetic, endocrine, metabolic, environmental (social and cultural), behavioral and psychological components. Today, about 100 million people in the world are obese, severe forms of the disease or morbid obesity occur in 3-5% of adults in economically developed countries[24].
Clinical experience shows that conservative treatment helps overweight patients only in the early stages of the disease. Many scientific and practical studies have proven that conservative treatment in morbid obesity is ineffective or the effect of such therapy is insignificant and short-term[1,16,5].
Analysis shows that the cost of fighting obesity in developed countries is 8-10% of the total annual health costs. Obesity usually leads to an increase in the cost of treating all the

comorbidities associated with it. The economic costs of treating patients with morbid obesity or TMI > 35 are 3 times higher than those with normal body weight [8,12,17].
Based on the listed controversial cases of morbid obesity, clinicians from different countries are looking for new and highly effective methods of treating morbid obesity, including surgical methods [2,15,9].
Currently, bariatric surgery is a commonly accepted method of treating obesity and accompanying metabolic diseases [13,10,11,4,6,7].

Purpose of the Study

To research the effectiveness of sleeve gastrectomy in assessing and improving hemostasis in patients with morbid obesity.

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 sleeve gastrectomy (SG). In recent years, the number of patients with morbid obesity has increased, and the scope of OBR 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. Among the studied patients, depression was found in 22 (15.0%) patients, sleep apnea in 14 (9.5%), infertility in 6 (4%) women, and decreased libido in 12 (8.0%) patients. Such changes were assessed as complications related to morbid obesity, and these indicators were dynamically observed after the operation[22].
It is known that, especially as a result of morbid obesity, cell stress occurs as a result of the increase in fat mass of adipocytes and they produce many pro-inflammatory cytokines and chemoattractants for immunocytes, especially macrophages, which leads to their accumulation in adipose tissue. As a result, the induction of pro-inflammatory cytokine production by accumulated macrophages and adipocytes leads to the development of a characteristic weak but chronic inflammatory state in morbid obesity [21,23].
Pro-inflammatory cytokines produced in chronic inflammatory conditions activate endotheliocytes, increase production of procoagulant and adhesion factors, and decrease anticoagulant factors, leading to thrombin generation and platelet activation [14]. Similarly, obesity-induced lipid profile disturbances increase the development of

atherosclerosis, which causes endothelial dysfunction. In addition, increased production of plasminogen activator inhibitor-1 (PAI-1) factor in obesity has a negative effect on the process of fibrinolysis [18]. These factors create conditions for the emergence of a specific hypercoagulable state in morbid obesity, and the frequency of thrombosis and thromboembolism in such patients is high.

Results obtained and discussion. Coagulation factors are of great practical importance in evaluating the effectiveness of surgical procedures performed in the main and control groups in patients with morbid obesity. To study the vascular-platelet stage of hemostasis, we counted the number of platelets in the blood analysis. The study showed that in the control group this indicator was 244±38.9 x109/l, while the average amount of platelets in the main and control groups was ...x109/l and ...x109/l. Analysis of the number of platelets according to the degree of obesity, in the main and control groups of patients with 2nd degree obesity, this indicator is ...x109/l and ...x109/l, and in 3rd degree obesity - ...x109/l and ...x109/l organized. The obtained results showed that thrombocytosis develops to a certain degree in obesity and that this indicator depends on the degree of obesity. This showed an increase in platelet function and a tendency to hypercoagulability in patients.

Coagulation hemostasis consists of a cascade of reactions involving plasma factors. In the group of healthy donors, activated partial thromboplastin time (APTT) was 32.1±0.93 seconds, while in the main and control group of patients suffering from obesity, the APTT time in plasma was 21.82±0.50 (P<0.01) and 24.98±0.57 (P<0.01) was observed to be reduced to seconds. When we analyzed the APTT indicator according to the level of obesity, if in the 2nd degree of obesity it was observed to be reduced to 23.07±0.74 (P<0.01) and 24.98±0.57 (P<0.01) seconds, then in the 3rd degree of obesity it was observed it was found to be reduced to 20.98±0.65 (P<0.001) and 25.75±0.71 (P<0.01) seconds in patients in the main and control groups, that is, it did not depend much on the degree of obesity. Reduction of APTT index in obese patients compared to healthy donors indicated a hypercoagulable shift in the first stage of plasma hemostasis (Table 1).

Table 1 Assessment of the first stage of blood coagulation in obese patients with APTT (seconds), M±m

Groups	Main group	Control grou
Main	21,82±0,50**	24,98±0,57**
2nd degree obesity, n=20	23,07±0,74**	24,98±0,57**
3rd degree obesity, n=25	20,98±0,65***	25,75±0,71**
Healthy donors, n=15	32,1±0,93	

Note: * - the difference compared to the indicators of the group of healthy donors is reliable (*-R<0.05; **-R<0.01; *** - R<0.001)

To characterize the second stage of plasma hemostasis, prothrombin time, prothrombin index and international normalized ratio(INR) were studied (Table 2). Prothrombin time, PTI and INR did not change much in obese patients and did not differ from normal indicators.

The study of indicators of the second stage of blood coagulation showed that there were no changes in the second stage of coagulation hemostasis in obese patients.

Table 2. Assessment of the second stage of blood coagulation in obese patients, M±m

Groups	PT,second	PTI, %	INR
Healthy, n=12	12,81±1,14	98,52±7,23	1,00±0,09
Main, n=46	12,99±0,29	98,57±1,64	1,09±0,04
2nd degree, n=20	13,24±0,38	98,09±2,85	1,14±0,04
3rd degree, n=26	12,85±0,41	98,96±1,95	1,05±0,06
Control, n=45	13,71±0,37	99,06±1,93	1,18±0,05
2nd degree, n=25	13,71±0,37	99,06±1,93	1,18±0,05
3rd degree, n=20	13,44±0,57	100,20±2,65	1,22±0,08

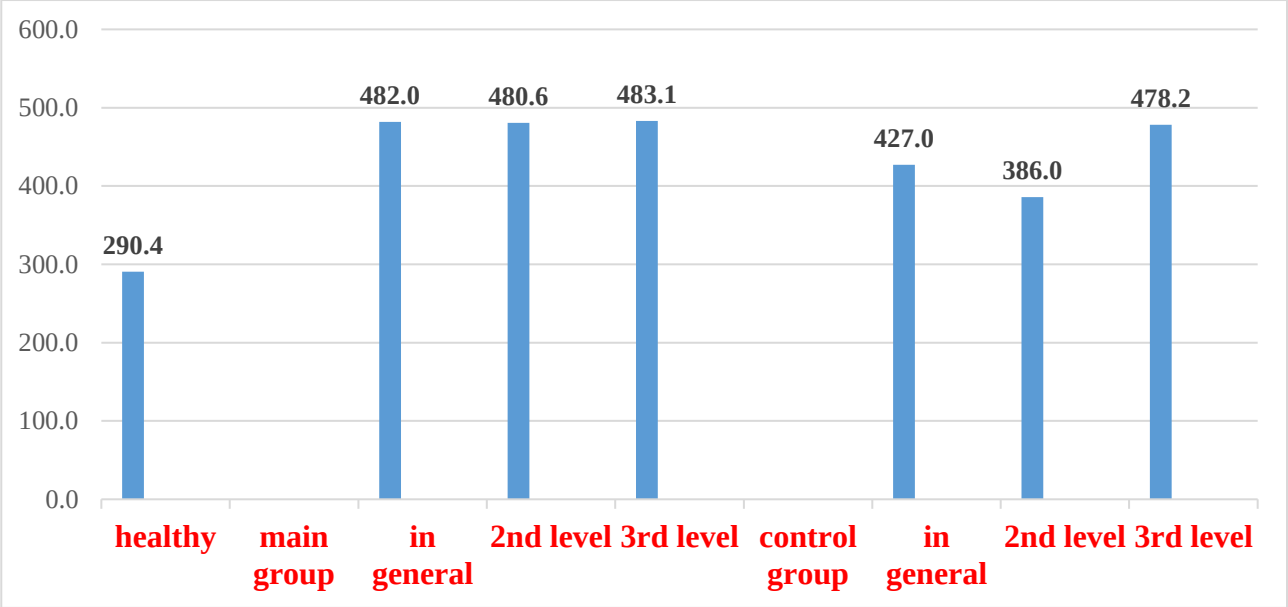
Note: * - the difference compared to the indicators of the healthy group is reliable (*-R<0.05; **-R<0.01; *** - R<0.001).

To characterize the third stage of blood coagulation, the amount of fibrinogen was determined (see Figure 1). The study of the amount of fibrinogen showed a significant increase in the concentration of fibrinogen, which indicated the existence of a hypercoagulable shift in the third stage of blood clotting coagulation hemostasis. In particular, in patients in the main and control groups, the amount of fibrinogen increased by 1.66 (P<0.01) and 1.47 (P<0.015) times compared to the standard values, 482.00±21.66 and 426.98±16.83 mg% In 2nd degree obesity, the amount of fibrinogen increased by 1.65 (P<0.01) and 1.33 (P<0.05) times to 480.60±31.31 and 386.00±15.88, respectively. mg% increased to 1.66 (P<0.01) and 1.65 (P<0.01) in the main and control groups with grade 3 obesity, and these indicators were 483.12±28.81 and increased to 478.20±29.10 mg%. In the group of healthy donors, this indicator was 290.4±60.5 mg%.

In conclusion, the study of the third stage of blood coagulation showed hypercoagulability in all groups with high BMI compared to the control group.

So, in general, in patients with obesity, significant shifts in vascular thrombocytic and coagulation hemostasis are observed, indicating the presence of a tendency to hypercoagulation. This, in our opinion, can be associated with the activation of vascular

thrombocytic hemostasis, the reduction of NO oxide production due to atherosclerotic damage to the endothelium. A decrease in the amount of nitric oxide increases platelets and erythrocytes and increases blood viscosity. At the same time, the insulin resistance observed in obesity leads to the activation of the synthesis of plasminogen activator inhibitor, which leads to the reduction of fibrinolysis, and with it, the activation of other procoagulant factors [2].



1-picture. The amount of fibrinogen in the blood serum of patients (mg%).

As a proof of these opinions, we conducted a correlational analysis between the atherosclerosis coefficient and hemocoagulation markers, which provide information about the state of atherosclerosis that induces hemocoagulation dysfunction in the case of obesity, according to the indicators before surgery. The obtained results showed a weak inverse relationship between the atherogenic coefficient and prothrombin time in obese patients ($r=-0.33$; $P<0.05$), and a weak inverse relationship with INR ($r=-0.39$; $P<0.05$). if detected, no statistically reliable correlation was found with APTT ($r=0.28$; $P>0.05$) and fibrinogen ($r=-0.21$; $P>0.05$).

It is known that arterial hypertension in metabolic syndrome is caused by biologically active substances produced in adipose tissue, including aldosterone secretion enhancing factor synthesized in adipocytes [9,22]. However, it should be said that arterial hypertension itself is the main factor in the development and acceleration of atherosclerosis. The main reason for this is endothelial dysfunction. According to the authors, this results in dangerous circulation, and endothelial dysfunction leads to cardiovascular disease, which in turn exacerbates endothelial damage.

American Journal of Interdisciplinary Research and Development
ISSN Online: 2771-8948
Website: www.ajird.journalspark.org
Volume 35, December - 2024

Table 3. Effect of bariatric surgery on APTT (seconds), M±m

Groups	Main group		Control group	
	Before treatment	After 6 months	After treatment	After 6 months
Main	21,82±0,50*	24,40±0,63*	24,98±0,57*	25,24±0,53*
2nd degree obesity, n=20	23,07±0,74*	24,93±1,00*	24,98±0,57*	25,04±0,72*
3rd degree obesity, n=25	20,98±0,65*	23,99±0,81*	25,75±0,71*	25,50±0,81*
Healthy donors, n=15	32,1±0,93			

Note: * - the difference compared to the indicators of the group of healthy donors is reliable (R<0.05); ^ - differences between pre-treatment and post-treatment indicators are reliable (R<0.05).

Similarly, changes in coagulation parameters depending on the degree of obesity as a result of longitudinal resection of the stomach performed in the main group during the study were examined (Table 3). When we analyzed the first stage of coagulation hemostasis, a tendency to lengthen APTT was observed in the main and control groups 6 months after surgery. No differences were found between the groups, and all scores were statistically significantly shorter than the norm. The obtained results show that the tendency to hypercoagulability remains in the first stage of plasma hemostasis.

Table 4. Effect of bariatric surgery on prothrombin time (seconds), M±m

Groups	Main group		Control group	
	Before treatment	After 6 months	After treatment	After 6 months
Main	12,99±0,29	10,67±0,24	13,71±0,37	11,53±0,35
2nd degree obesity, n=20	13,24±0,38	10,77±0,28	13,71±0,37	11,45±0,54
3rd degree obesity, n=25	12,85±0,41	10,61±0,37	13,44±0,57	11,63±0,42
Healthy donors, n=15	12,81±1,14			

Note: * - the difference compared to the indicators of the group of healthy donors is reliable (R<0.05).

In particular, the time of APTT in the plasma in the main and control group patients was shorter by 1.32 (R<0.05) and 1.27 (R<0.05) compared to the standard parameters. In 2nd degree obesity they are 1.29 (R<0.05) and 1.28 (R<0.05) times, and in 3rd degree obesity

they are 1.34 (R<0.05) and 1.26 (R<0, 05) was found to be short compared to standard indicators. The parameters of the second stage of plasma hemostasis in the main and control groups did not differ significantly from their pretreatment values after surgery. Prothrombin time (Table 4), PTI (Table 5) and INR (Table 6) did not change much in obese patients and did not differ from normal values.

That is, it showed that there were no changes in the second stage of coagulation hemostasis. A statistically significant decrease of 1.46 (R<0.05) and 1.34 (R<0.05) was observed in the main and control groups after 6 months of surgery, which represents the 3rd stage of coagulation hemostasis (Table 7).

Table 5. Effect of bariatric surgery on prothrombin index (%) indicator, M±m

Groups	Main group		Control group	
	Before treatment	After 6 months	After treatment	After 6 months
Main	98,57±1,64	80,07±1,33	99,06±1,93	85,44±1,62
2nd degree obesity, n=20	98,09±2,85	80,75±2,27	99,06±1,93	85,16±2,32
3rd degree obesity, n=25	98,96±1,95	79,54±1,62	100,20±2,65	85,80±2,26
Healthy donors, n=15	98,52±7,23			

Note: * - the difference compared to the indicators of the group of healthy donors is reliable (R<0.05).

Table 6. Effect of bariatric surgery on INR indicator, M±m

Groups	Main group		Control group	
	Before treatment	After 6 months	After treatment	After 6 months
Main	1,09±0,04	0,95±0,03	1,18±0,05	1,00±0,03
2nd degree obesity, n=20	1,14±0,04	0,95±0,03	1,18±0,05	1,03±0,05
3rd degree obesity, n=25	1,05±0,06	0,95±0,04	1,22±0,08	0,97±0,03
Healthy donors, n=15	1,00±0,09			

Note: * - the difference compared to the indicators of the group of healthy donors is reliable (R<0.05).

In the 2nd degree of obesity, fibrinogen content decreased by 1.35 (P<0.05) and 1.32 (P<0.05) times in the groups compared to the pre-treatment values, while in patients with the 3rd degree of obesity, it decreased by 1.59 (P< 0.01) and 1.36 (P<0.01). Plasma

fibrinogen content remained statistically significantly higher than that of the healthy donor group.

Table 7. Effect of bariatric surgery on fibrinogen content (mg%), M±m

Groups	Main group		Control group	
	Before treatment	After 6 months	After treatment	After 6 months
Main	482,0±21,7*	330,4±15,0^	427,0±16,8*	319,0±10,2^
2nd degree obesity, n=20	480,6±31,3*	356,7±25,7^	386,0±15,9*	293,2±11,1^
3rd degree obesity, n=25	483,1±28,8*	310,1±17,0^	478,2±29,1*	351,1±15,7^
Healthy donors, n=15	290,4±60,5			

Note: * - the difference compared to the indicators of the group of healthy donors is reliable (R<0.05); ^ - differences between pre-treatment and post-treatment indicators are reliable (R<0.05).

In all parameters presented in Table 7, a statistically significant positive change was found after longitudinal resection of the stomach compared to the control group. Despite the decrease in all indicators, the tendency to increase compared to the norm remained. The obtained results showed that bariatric procedures in obesity had a positive effect on the 3rd stage of coagulation hemostasis and led to the elimination of hypercoagulation. These results indicate that the surgical procedure performed in the main group was an effective treatment regardless of the degree of obesity in the patients.

The results obtained in this way indicate a tendency to hypercoagulability in vascular-platelet and coagulation hemostasis in obese patients. It was not determined that it was related to the level of obesity, which is characteristic of the first and third stages of obvious coagulation hemostasis. In order to determine the association of serum lipid parameters with BMI, we analyzed correlational associations. The obtained results revealed negative medium correlations between the amount of Cholesterol in HDLs and BMI in the main and control groups. Triacylglycerides, total cholesterol, cholesterol content in LDLs and glucose were moderately positive. The obtained results indicate that such patients have a tendency to diseases of the cardiovascular system.

A clear statistically significant positive change was found after longitudinal resection of the stomach compared to the control group. Despite the decrease in all indicators, the tendency to increase compared to the norm remained. The obtained results showed that bariatric procedures in obesity had a positive effect on the 3rd stage of coagulation hemostasis and led to the elimination of hypercoagulation. These results indicate that the surgical procedure performed in the main group was an effective treatment regardless of the degree of obesity in the patients.

Conclusions:

1. In morbid obesity, depending on its severity, statistically reliable disturbances in the amount of hemostasis indicators of patients were observed, and an average positive connection with BMI was determined; It was even higher in patients with genetic predisposition and comorbid conditions such as diabetes;
2. Despite the obvious statistically significant positive changes after longitudinal resection of the hemostasis of the control group, the tendency to increase the coagulation hemostasis in the 1st and 3rd stages compared to the norm remained. Surgery performed in the main group showed that the treatment was effective regardless of the degree of obesity in patients.

References:

1. Achkasov E.E. Pathogenetic approach when choosing methods of conservative treatment of obesity and correction of excess body weight. / Achkasov E.E., Razina A.O., Runenko S.D.. // Clinical medicine: Scientific and practical journal. JSC "Publishing House "Medicine". - 2016. - T. 94, No. 7. - P. 509-517.
2. Adams K. et al., 2014, Bray G.A. (2017) Obesity: a chronic relapsing progressive disease process. A position statement of the World Obesity Federation. Obes Rev., vol. 18(7), pp. 715–723
3. Ametov A.S. Diabetes mellitus type 2: problems and solutions.7– M.: GEOTAR-Media, 2012.7– 704 p.
4. Aminian A., Zajichek A., Arterburn D.E. et al. Association of metabolic surgery with major adverse cardiovascular outcomes in patients with type 2 diabetes and obesity // JAMA. 2019. Vol. 322, N 13. P. 1271-1282. DOI: https://doi.org/10.1001/jama.2019.14231
5. Cena H. Evaluation of eating habits and lifestyle in patients with obesity before and after bariatric surgery: a single Italian center experience. / H. Cena, R. De Giuseppe, G. Biino, F. Persico, A. Ciliberto. // Springerplus [Springerplus]. – 2016 Sep 01 (Date of Electronic Publication: 2016/09/01). – Vol. 5 (1). – P. 1467., 312, 313
6. Cherla, D.V.; Rodriguez, N.A.; Vangoitsenhoven, R.; Singh, T.; Mehta, N.; McCullough, A.J.; Brethauer, S.A.; Schauer, P.R.; Aminian, A. Impact of sleeve gastrectomy and Roux-en-Y gastric bypass on biopsyproven non-alcoholic fatty liver disease. *Surg. Endosc.* 2020, *34*, 2266–2272.
7. Fakhry, T.K.; Mhaskar, R.; Schwitalla, T.; Muradova, E.; Gonzalvo, J.P.; Murr, M.M. Bariatric surgery improves nonalcoholic fatty liver disease: A contemporary systematic review and meta-analysis. *Surg. Obes. Relat. Dis.* 2019, *15*, 502–511, doi:10.1016/j.soard.2018.12.002.
8. Grishkyan D.R. Strategy and tactics for diagnosis and surgical treatment of obesity and its consequences: dissertation. ... doc. honey. Sciences: 01/14/17 – surgery; 01/14/02 – endocrinology. – Moscow, 2011. – 216 p.

9. Hafida S. The impact of bariatric surgery on inflammation: quenching the fire of obesity? / S. Hafida, T. Mirshahi, B.S. Nikolajczyk. // Current Opinion In Endocrinology, Diabetes, And Obesity [Curr Opin Endocrinol Diabetes Obes]. – 2016 Oct. – Vol. 23 (5). – P. 373-378.
10. Khatkov I.E., Tsvirkun V.V., Chudnykh S.M., Askerkhanov R.G., Feydorov I.Yu., Petrova A.L. Prevention, diagnosis and treatment of anastomotic leakage after laparoscopic gastric bypass with a Roux-en-Y loop. Endoscopic surgery. 2021;27(4):5–10. https://doi.org/10.17116/endoskop2021270415
11. Khitaryan A. G., Starzhinskaya O. B., Mezhunts A. V., Orekhov A. A. Evaluation of the effectiveness of the antireflux mechanism of the modified technique of laparoscopic longitudinal gastrectomy with the formation of a three-chamber gastric “sleeve” in patients with morbid obesity. Bulletin of surgery named after I. I. Grekov. 2020;179(1):51–57. DOI: 10. 24884/0042-4625-2020-179-1-51-57.
12. Kochetova O.V. Association of polymorphic variants of the FTO and MC4R genes with the development of obesity in the Tatar population. / O.V. Kochetova [and others]. // Genetics, Monthly magazine Ros. Academy of Sciences. - 2015. - T. 51, No. 2, February. — P. 248-255.
13. Kornyushin O.V., Sakeyan I.S., Kravchuk E.N., Vasilevsky D.I., Danilov I.N., Neimark A.E. Prediction of remission of type 2 diabetes mellitus after bariatric surgery // Diabetes mellitus. - 2021. - T. 24. - No. 6. — p. x565-570. doi: https://doi.org/10.14341/DM12814
14. Levi M, van der Poll T, Schultz M. Infection and inflammation as risk factors for thrombosis and atherosclerosis. Semin Thromb Hemost. 2012;38:506–514.
15. Murodov A.S., Teshaev O.R., Mavlyanov O.R. Method of processing the stapler line of the cardioesophageal area in longitudinal resection of the stomach.. №. IAP 07203. 11/30/2022.
16. Muzhikov S.P. Comparative assessment of the effectiveness of restrictive gastric surgeries in patients with obesity and metabolic syndrome: dissertation. ...cand. honey. Sciences: 01/14/17 – surgery. – St. Petersburg, 2015. -152 p.
17. Neumann K. Is obesity associated with advanced stage or grade of colon cancer? / K. Neumann, et al. // Canadian journal of surgery. Journal canadien de chirurgie. – 2015. – 58:2. – P. 140-142.
18. Samad F, Loskutoff DJ. Tissue distribution and regulation of plasminogen activator inhibitor-1 in obese mice. Mol Med. 1996;2:568–582.
19. Schiavon CA, Bersch-Ferreira AC, Santucci EV, et al. Effects of Bariatric Surgery in Obese Patients With Hypertension: The GATEWAY Randomized Trial (Gastric Bypass to Treat Obese Patients With Steady Hypertension). Circulation. 2018; 137(11): 1132-1142. https://doi.org/10.1161/CIRCULA-TIONAHA.117.032130.
20. Sedletsky Yu.I. Surgical treatment of metabolic syndrome. – St. Petersburg: ELBI-SPb, 2014. – 192 p.

21. Tchernof A, Despres JP. Pathophysiology of human visceral obesity: an update. Physiol Rev. 2013;93:359–404.,
22. Teshaev O.R., Murodov A.S., Mavlyanov O.R. Analysis of the results of longitudinal gastrectomy in patients with morbid obesity “New Day in Medicine” 2022.9(47).-P. 165-170 p.
23. Vandanmagsar B, Youm YH, Ravussin A, et al. The NLRP3 inflammasome instigates obesity-induced inflammation and insulin resistance. Nat Med. 2011;17:179–188.
24. Yashkov Yu. I., Zvenigorodskaya L. A., Mishchenkova T. V. Modern approaches to the treatment of obesity. Experimental and clinical gastroenterology. 2012. No. 11.-S. 3-10