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MODIFIED METHOD OF LAPAROSCOPIC LONGITUDINAL GASTRIC RESECTION IN SURGICAL TREATMENT OF PATIENTS WITH METABOLIC SYNDROME AGAINST THE BACKGROUND OF GASTROESOPHAGEAL REFLUX DISEASE

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Summary

Obesity and metabolic syndrome represent significant risk factors for the development of cardiovascular diseases, which are statistically the leading cause of mortality [1]. This underscores the necessity of conducting scientific research on pathologies characterized by a comorbid course [2].

***Purpose of the study:** Development of a modified technique for laparoscopic longitudinal gastric resection in the surgical treatment of patients with metabolic syndrome complicated by gastroesophageal reflux disease.*

***Materials and methods.** The study is based on a double-cohort comparative analysis of two patient groups selected between 2020 and 2023. A total of 120 patients were included in the study. The control group comprised patients treated and examined in the Department of Surgery at the Multidisciplinary Clinic of the Tashkent Medical Academy from 2020 to 2021, while the main group included patients treated from 2022 to 2023.*

***Results and their discussion.** In the early postoperative period and during follow-up up to 30 days, there was a trend toward improvement in laboratory parameters characterizing the manifestations of metabolic syndrome. Fasting glycemia levels decreased, and laboratory indicators of dyslipidemia normalized. Moreover, the changes in these parameters on days 14-30 of the postoperative period became statistically significant compared to baseline values.*

***Conclusions.** The application of modified laparoscopic longitudinal gastric resection in patients with metabolic syndrome and concomitant gastroesophageal reflux disease led to improved long-term treatment outcomes. Specifically, the frequency of «excellent» results increased from 11.1% to 23.3% of cases (a 2.1-fold increase), while «good» results increased from 22.2% to 50% (a 2.25-fold increase). Additionally, cases with «unsatisfactory» treatment outcomes were completely eliminated. The frequency of repeated hospitalizations decreased by 3.9 times, and the number of bed-days was reduced by 3 times. These findings indicate enhanced treatment efficacy, improved quality of life, and a reduction in the period of work incapacity.*

***Keywords:** Gastroesophageal Reflux Disease; Metabolic Syndrome Patients; Laparoscopic Longitudinal Gastric Resection; Outcome.*

Introduction

Obesity and metabolic syndrome (MS) represent significant contributors to the onset of cardiovascular diseases, which are the leading cause of mortality according to statistical data [1]. These findings highlight the critical need for further scientific investigation into pathologies that present with comorbid conditions [2].

Metabolic syndrome (MS) is strongly associated with the onset of various gastroenterological disorders, including diseases of the oesophagus (72%), hepatobiliary system (69%), and large intestine (64%) [3]. Abdominal obesity, as a manifestation of MS, is well-established as a risk factor for gastroesophageal reflux disease (GERD), Barrett's esophagus, and several types of cancer, including esophageal adenocarcinoma [4, 5]. It is hypothesized that abdominal obesity contributes to the development of GERD by increasing intra-abdominal pressure, which impairs gastric emptying, reduces the pressure of the lower esophageal sphincter, and elevates the frequency of sphincter relaxation, ultimately leading to prolonged acid exposure of the esophageal mucosa [6].

The use of bariatric surgery has risen significantly over the past three decades due to its demonstrated effectiveness in treating obesity and metabolic syndrome (MS) [7, 8, 9]. The most frequently performed bariatric procedures include gastric bypass [10] and longitudinal gastric resection [11]. Potential mechanisms by which gastric bypass with Roux anastomosis alleviates symptoms of gastroesophageal reflux disease (GERD) include bile diversion from the esophagus [12], cessation of gastric acid production, or a reduction in the volume of acidic contents [13].

However, the majority of studies investigating the impact of bariatric surgery on GERD exhibit significant heterogeneity, including variations in follow-up duration (ranging from 6 months to 5 years), differences in the diagnostic criteria for esophageal pathology, and the absence of control groups [14, 15, 16]. Consequently, it remains challenging to definitively determine the effect of laparoscopic longitudinal gastric resection (LLGR) on GERD in patients with MS [17].

These factors have prompted more in-depth research to identify solutions for the treatment of MS complicated by GERD. Recent data indicate a direct correlation between the prevalence of obesity and the incidence of erosive esophagitis, Barrett's oesophagus, and esophageal adenocarcinoma, all of which are manifestations of GERD [18]. Research conducted over the past 50 years has revealed a strong correlation between the rise in populations with elevated BMI and the prevalence of esophageal and gastric pathologies across different continents [19, 20, 21, 22].

In addition, evidence suggests that central abdominal obesity, rather than elevated body mass index (BMI), is the most significant factor associated with GERD, particularly Barrett's esophagus [23].

A systematic review has estimated the prevalence of GERD to range from 18.4% to 28.1% [24]. Studies conducted in collaboration with the U. S. National Health Center have confirmed a progressive increase in the number of patients with obesity complicated by MS. Over the past 20 years, the frequency of MS diagnoses in the context of GERD has steadily increased [25, 26].

A cross-sectional epidemiological study led by a group of researchers revealed a higher prevalence of GERD in individuals with MS compared to those without this condition [27]. To corroborate these findings, an additional questionnaire was included in the Nurses' Health Study to assess reflux symptoms, showing a nearly linear increase in GERD symptom frequency correlated with BMI in each group.

In conclusion, bariatric surgery represents an effective intervention for improving various parameters of MS, and existing data generally suggest that weight loss can positively influence GERD. However, to achieve complete resolution of GERD following standard bariatric procedures, the development and application of modified techniques are necessary, which, in our view, will substantially enhance both immediate and long-term outcomes for patients with MS. These considerations have determined the primary focus of this research.

Purpose of the study. Development of a modified technique for laparoscopic longitudinal gastric resection in the surgical treatment of patients with metabolic syndrome complicated by gastroesophageal reflux disease.

Materials and methods

Work is based on a double cohort comparative analysis of two groups of patients who were selected over the years 2020 to 2023.

A total of 120 patients participated in the study. The control group consisted of patients treated and examined in the Department of Surgery at the multidisciplinary clinic of the Tashkent Medical Academy from 2020 to 2021 (60 patients), while the main group included patients treated from 2022 to 2023 (60 patients). This department is the clinical base of the Department of Faculty and Hospital Surgery No. 1 of the Tashkent Medical Academy (Head of the Department, Doctor of Medical Sciences, Professor M. Sh. Hakimov). The inclusion criteria for patients in the cohorts were as follows:

– written consent of the patient to participate in the study;

– patient's age over 18 years;

– diagnosis of metabolic syndrome accompanied by gastroesophageal reflux disease;

The exclusion criteria for patients from the cohorts were:

– absence of written consent of the patient to participate in the study;

– patient's age below 18 years;

– presence of peptic oesophageal stricture, Barrett's oesophagus or oesophageal adenocarcinoma.

The primary distinction between the control and experimental groups was that patients in the control group underwent the traditional version of LLGR as a form of bariatric surgery, while patients in the experimental group received a modified LLGR technique developed by the authors. This modification aimed to create conditions that would prevent the development of GERD in patients with MS.

Female patients predominated in both groups. The characteristic of mean age had acceptable ranges of differences. The majority of patients suffered from comorbidities. It should be noted here that the presence of diseases from the cardiovascular system (arterial hypertension), GI (GERD) and endocrine (DM2T) systems was obligatory, naturally all patients had such pathologies (table 2).

Table 1

Main comparative characteristics of the patients

Characteristic values		Patient groups		Total
		Control group	Main group	
Quantity, abs (%)		60 (50%)	60 (50%)	120 (100%)
Sex	Male, abs (%)	15 (25%)	16 (26,7)	31 (25,8)
	Female, abs (%)	45 (75%)	44 (73,3)	89 (74,2)
Average age		38,1±9,6	37,3±6,1	37,7±7,85

Table 2

Associated diseases of the body systems

Body systems	Patient groups	
	Control	Main
Cardiovascular	60 (21%)	60 (21%)
Digestive	60 (21%)	60 (21%)
Endocrine	60 (21%)	60 (21%)
Musculoskeletal	44 (15,4%)	39 (13,8%)
Respiratory	36 (12,6%)	41 (14,5%)
Genitourinary	15 (5,2%)	13 (4,6%)
Nervous	11 (3,8%)	9 (3,2%)

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The technique of traditional LLGR included the sequential execution of 10 main stages of the operation: mobilization of the gastro-diaphragmatic ligament, creation of access to the omental bursa, mobilization of the stomach, placement of a calibration tube, resection of the stomach, reinforcement of the staple line, removal of the calibration tube, inspection for the resected stomach, and drainage of the abdominal cavity.

Since the diagnosis of MS is based on the principles of identifying several pathological conditions, more detailed information regarding concomitant conditions will be presented separately.

When performing conventional LLGR, the esophageal aperture of the diaphragm was reinforced by suturing the posterior and anterior crura, and an antireflux position was established by suturing the residual fundal portion of the stomach to the esophagus via the anterior crura.

In patients of the main group, in accordance with the methodology outlined in our guidelines («Method of laparoscopic longitudinal gastric resection in patients with metabolic syndrome complicated by gastroesophageal reflux disease,» FAP № 2610 dated 17.10.2024), following the crurorаphy stage, the free portion of the greater omentum was mobilized on a vascular pedicle of sufficient length to allow its transfer to the diaphragmatic surface of the abdominal cavity, thereby forming a cuff around the abdominal part of the oesophagus.

As previously described, the control group comprised 60 patients who underwent conventional LLGR, supplemented with crurorаphy and the creation of an antireflux gastric position.

Results and their discussion

In the early postoperative period and during follow-up up to 30 days (the period of immediate treatment outcomes), the dynamics of changes in laboratory parameters characterizing the manifestations of MS demonstrated a trend toward improvement. Fasting glycemia levels decreased, and laboratory indicators of dyslipidemia normalized (Table 3). Furthermore, the changes in these parameters on days 14-30 of the postoperative period became statistically significant compared to baseline values. In other words, the application of conventional LLGR had a positive impact on improving the laboratory markers of MS.

Against this background, stabilization of blood pressure was observed, with the average level reaching 128.9 ± 12.3 mmHg. These findings can be regarded as evidence of the effectiveness of conventional LLGR in patients with MS complicated by GERD.

Table 3

Dynamics of changes in biochemical indicators of MS in blood in patients of the control group

Indicators	Dynamics of the study			
	3-day	7-day	14-day	30-day
Fasting glycaemia (mmol/l)	6,51±2,2	6,28±1,93	5,63±1,12*	5,43±0,32*
Total cholesterol (mmol/l)	6,36±2,31	5,11±1,21	4,64±1,62*	3,73±1,18*
Triglycerides (mmol/l)	1,71±0,13	1,59±0,29	1,36±0,15*	1,08±0,15*
LDL cholesterol (mmol/l)	3,32±0,63	2,98±0,51	2,39±0,75*	2,11±0,33*

**p<0,05 – reliable in relation to the level of the corresponding indicator at 3 days of postoperative period.*

However, it should be noted that during this study period, particularly in the first two intervals (3-7 days), patients remained in the clinic under strict dietary restrictions, often including the use of parenteral nutrition. In our opinion, this could have influenced the observed trend toward normalization of blood parameters and blood pressure levels.

To obtain more reliable results regarding the effectiveness of conventional LLGR, it is necessary to consider the outcomes of the distant postoperative period, which will be described later.

Clinical signs of GERD during the evaluation of immediate treatment outcomes in the control group were documented 312 times in medical records, indicating an average of 1.3 signs per patient.

When compared with the preoperative period, no significant changes in the number of clinical signs (in particular complaints) of GERD were observed following the application of conventional LLGR.

The most frequently reported symptoms included heartburn (51.3%), followed by odynophagia (21.5%), dysphagia (18.3%), regurgitation (6.1%), and belching (2.9%).

Overall, no statistically significant differences in the frequency of clinical signs of GERD were identified. The minor reduction in clinical signs of GERD during the postoperative period was attributed solely to the reduction in stomach volume and the use of probe decompression on the day following LLGR.

However, starting from day 14 of the postoperative period, clinical signs of GERD returned to baseline levels observed in the preoperative period. This directly indicates the limited efficacy of conventional LLGR in patients with MS complicated by GERD, even when supplemented with crurorаphy and antireflux positioning of the stomach.

In the control group, clinical signs of GERD were noted in 60 cases on the 3rd postoperative day, accounting for 19.2% of the total number of cases during the study period, with an average of 1 sign per patient. Heartburn (48.3%) and odynophagia (35%) were the most prevalent symptoms – Table 4.

Almost the same level of clinical signs of GERD manifestation was observed on day 7 of the postoperative period, with an average of 1.05 complaints per patient.

Meanwhile, already on 14-30 days of the postoperative period on the average per 1 patient there were 1.35 and 1.8 clinical signs of GERD, which indicated the progression of this disease. It should be noted that the dynamics of the frequency of such clinical sign as belching progressively decreased (3 times), which, apparently, was associated with a decrease in the volume of the stomach.

Table 4

Dynamics of changes in the frequency of clinical signs of GERD in MS patients after application of conventional LLGR

Signs of GERD	Dynamics of the postoperative period							
	3-days		7-days		14-days		30-days	
	n	%	n	%	n	%	N	%
Heartburn	29	48,3	35	55,6	44	54,3	52	48,1
Odynophagia	21	35	16	25,4	16	19,8	14	13
Dysphagia	6	10	6	9,5	13	16	32	29,6
Belching	3	5	3	4,8	2	2,5	1	0,9
Regurgitation	1	1,7	3	4,8	6	7,4	9	8,3
Total	60	19,2	63	20,2	81	26	108	34,6
Average per 1 patient	1,0		1,05		1,35		1,8	

However, under these conditions, clinical signs such as regurgitation (9 occurrences) and dysphagia (more than 5 occurrences) worsened, which may directly suggest the persistence of the pathological process at the level of POP and the insufficiency of its sphincter mechanism. The results of these observations will be presented using the BAROS-2 scale.

We must acknowledge that, unfortunately, we were unable to resolve the issue of treating GERD under the conditions of conventional LLGR application.

In the postoperative period, 69 complications were recorded, averaging 1.15 complications per patient. This was due to the occurrence of multiple complications in the same patient.

According to the medical records, 9 distinct types of postoperative complications were observed in the control group of patients. Based on the Clavien-Dindo classification, 3 (33.4%) complications were classified as grade I, 4 (44.4%) as grade II, and 2 (22.2%) as grade III-A (Figure 1).

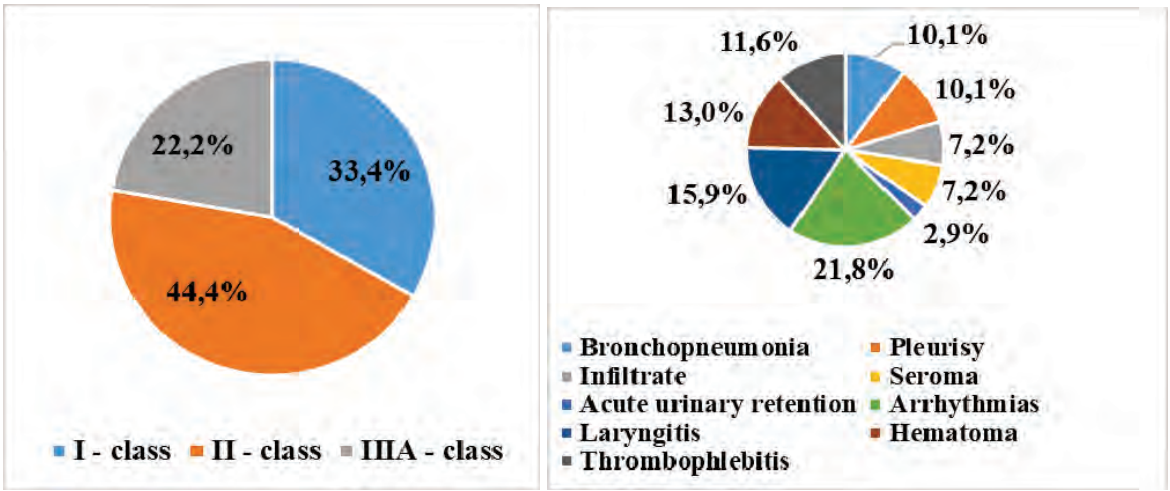

Fig 1. Postoperative complications in control group patients after conventional LLGR.

The class I complication subgroup encompassed postoperative wound hematoma and seroma, which did not necessitate any specialized medical or surgical intervention. All of these complications were easily resolved during the postoperative recovery period.

The class II complication subgroup included the onset of paroxysmal atrial fibrillation, saphenous vein thrombophlebitis, exacerbation of chronic laryngitis, and bronchopneumonia. These complications did not necessitate surgical treatment and were managed solely through additional pharmacological therapy.

The class III-A complication subgroup comprised exudative pleurisy and acute urinary retention. These complications required invasive interventions for resolution, including pleural puncture and bladder catheterization.

The most frequently observed complications were paroxysmal atrial fibrillation (class II, 15 cases – 21.7%), exacerbation of chronic laryngitis (class II, 11 cases – 15.9%), postoperative wound hematoma (class I, 9 cases – 13%), saphenous vein thrombophlebitis (class II, 8 cases – 11.6%), bronchopneumonia (class II, 7 cases – 10.1%), exudative pleurisy (class III-A, 7 cases – 10.1%), inflammatory wound infiltrate (class I, 5 cases – 7.2%), wound seroma (class I, 5 cases – 7.2%), and acute urinary retention (class III-A, 2 cases – 2.9%).

On the third postoperative day following conventional LLGR, a total of 15 complications (21.7%) were recorded, including subcutaneous wound hematomas in 4 patients (26.7%), paroxysmal atrial fibrillation in 3 patients (20%), exacerbation of chronic laryngitis in 3 patients (20%), postoperative wound seroma in 2 patients (13.3%), acute urinary retention in 2 patients (13.3%), and inflammatory wound infiltrate in 1 patient (6.7%) (Figure 2).

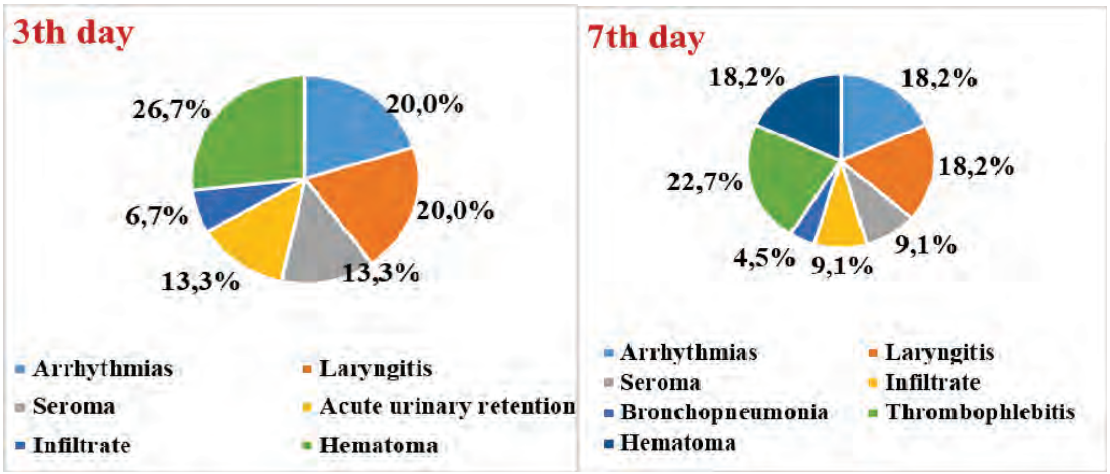

Fig 2. Dynamics of postoperative complications on days 3-7 in control group patients after conventional LLGR.

On the 7th postoperative day, we observed the highest incidence of complications (22 cases – 31.9%) following conventional LLGR, which included: saphenous vein thrombophlebitis in 5 (22.7%) patients, a complication not present in the earlier postoperative period; subcutaneous wound hematomas in 4 (18.2%) patients; paroxysmal atrial fibrillation in 4 (18.2%) patients; exacerbation of chronic laryngitis in 4 (18.2%) patients; seroma of the postoperative wound in 2 (9.1%) patients; inflammatory wound infiltrate in 2 (9.1%) patients; and bronchopneumonia in 1 (4.5%) patient.

On the 14th postoperative day, a total of 19 complications (27.5%) were identified following the application of conventional LLGR. These included paroxysmal atrial fibrillation in 5 patients (26.3%); bronchopneumonia in 4 patients (21.1%); saphenous vein thrombophlebitis in 2 patients (10.5%); exacerbation of chronic laryngitis in 2 patients (10.5%); inflammatory wound infiltrate in 2 patients (9.1%); and, for the first time, exudative pleuritis in 2 patients (9.1%). At this stage, complications such as subcutaneous hematoma formation and postoperative wound seroma were no longer observed (Figure 3).

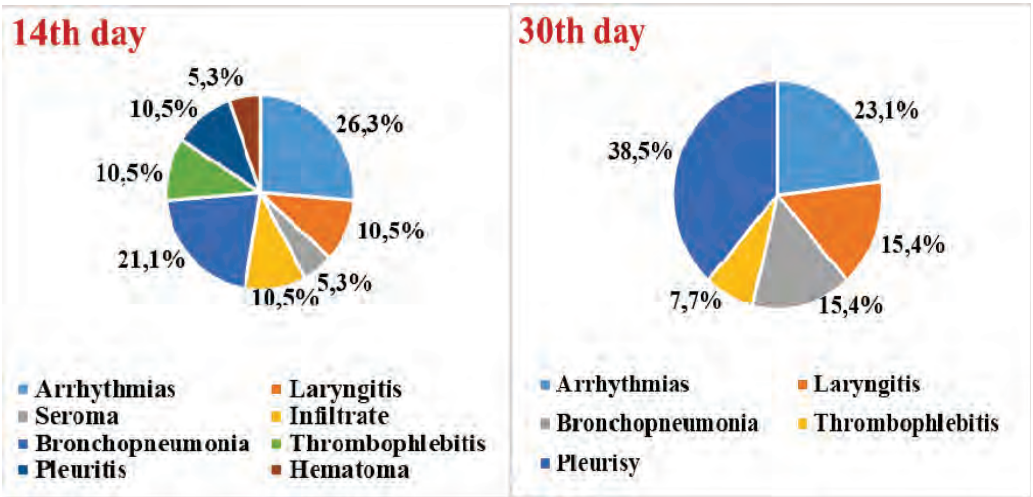

Fig 3. Dynamics of postoperative complications at 14-30 days in control group patients afterconventional LLGR.

On the 30th postoperative day, a total of 13 complications (18.8%) were identified following the application of conventional LLGR. These included exudative pleurisy in 5 patients (38.5%), paroxysmal atrial fibrillation in 3 patients (23.1%), bronchopneumonia in 2 patients (15.4%), and exacerbation of chronic laryngitis in 2 patients (10.5%).

Thus, the analysis of the dynamics of postoperative complication incidence revealed that in patients of the control group, following conventional LLGR, complications directly or indirectly associated with GERD predominated throughout the study period (up to 30 days).

It is important to note that, in this context, we are primarily referring to extraesophageal manifestations of GERD. Cardiological and otorhinolaryngological forms of lesions, which manifested in the postoperative period as rhythm disturbances and exacerbation of chronic laryngitis, were particularly prominent. Subsequently, in these patients, under favorable conditions, and in the presence of vagus nerve and laryngeal involvement, bronchopneumonia developed, and in severe cases, exudative pleuritis. The latter course was more severe and did not conform to the standards of clinical practice. As an example, an excerpt from the case history is provided.

Example. Patient B. D., born in 1968, case history # 381/63, was admitted for treatment and evaluation at the multidisciplinary clinic of the Tashkent Medical Academy for bariatric surgery due to obesity and type 2 diabetes mellitus (metabolic syndrome). During the examination, it was determined that the patient's metabolic syndrome was present against the background of gastroesophageal reflux disease (GERD). Instrumental investigations confirmed the presence of the extraesophageal manifestation of GERD in the form of chronic laryngitis and pharyngitis, clinically presenting with voice hoarseness and sore throat. The patient was also diagnosed with cardiac arrhythmia as a manifestation of ischemic heart disease. Additionally, according to the patient's account, gastroesophageal reflux episodes were associated with worsening arrhythmias, suggesting a possible etiological link between vagus nerve irritation and this disorder. Anthropometric measurements revealed a height of 1.85 meters, a weight of 112 kg, and a body mass index (BMI) of 41.1 kg/m².

Endoscopic examination revealed esophagitis and insufficiency of the esophagogastric sphincter. Laboratory tests demonstrated significant deviations, indicating hyperglycemia and dyslipidemia. Following preoperative preparation, the patient underwent laparoscopic longitudinal gastric resection with cruroraphy and fixation of the remaining portion of the gastric fundus and esophagus to the anterior crus of the diaphragm on 13.01.2021

On the 3rd postoperative day, the patient exhibited clinical symptoms of upper respiratory tract inflammation, including nasal congestion, productive cough, dyspnea, progressive hoarseness, and hyperthermia. Antibacterial therapy was continued. The patient was evaluated by a pulmonologist and an otorhinolaryngologist. Arrhythmic episodes occurred 3-4 times daily, necessitating appropriate pharmacological management. However, the patient's condition did not improve over time. Heartburn reappeared, accompanied by mild regurgitation of gastric contents, which subsequently progressed to refractory vomiting. The patient's body temperature remained at 38 °C, prompting a modification of the antibiotic regimen. On the 7th postoperative day, chest X-ray confirmed the diagnosis of bilateral focal bronchopneumonia. The patient was transferred to the pulmonology department, where ongoing therapy included repeated pleural cavity punctures over a 21-day period. Prior to discharge, residual signs of gastroesophageal reflux were observed, and appropriate pharmacological therapy was prescribed. A few days after discharge, the patient returned to the clinic with complaints of epigastric pain, nausea, and vomiting. According to the patient, these symptoms occurred after consuming spicy food. Abdominal ultrasound did not reveal significant pathology. However, endoscopic evaluation identified erosions in the distal oesophagus, covering two-thirds of the gastric mucosal surface.

The patient was re-hospitalized and received infusion and supportive therapy for five days. Due to persistent disordered eating behavior, similar episodes recurred three additional times. After six months, the patient's condition remained relatively stable, but no significant improvements were achieved postoperatively. This clinical case demonstrates that the patient had been suffering from an extraesophageal form of GERD for an extended period. Against this background, metabolic syndrome progressed, predisposing the patient to postoperative complications and necessitating additional therapeutic interventions. The immediate outcomes of conventional LLGR in the control group revealed relatively low rates of «excellent» and «good» results. At the same time, «satisfactory» outcomes predominated across all assessment categories. Unfortunately, in 3 (5.0%) patients, immediate treatment outcomes were classified as «unsatisfactory» (Table 5). When evaluating the average immediate treatment results over the entire study period, «excellent» outcomes were observed in 5.8±0.97 cases, accounting for 9.6% of overall effectiveness, representing the lowest value within the group.

The «good» immediate outcomes following conventional LLGR were recorded in 13.5±4.55 cases, corresponding to 22.5% of total effectiveness.

Table 5

The distribution of immediate treatment outcomes in control group patients following conventional LLGR

Immediate results	Dynamics of the postoperative period							
	3-days		7-days		14-days		30-days	
	n=60	%	n=60	%	n=60	%	n=60	%
Excellent	0	0	2	3,3	6	10	15	25
Good	0	0	13	21,7	28	46,7	13	21,7
Satisfactory	38	63,3	34	56,7	19	31,7	29	48,3
Unsatisfactory	22	36,7	11	18,3	7	11,7	3	5

The «satisfactory» immediate outcomes following the application of conventional LLGR amounted to 30±7.3 units, representing precisely half of all indicators within this category among patients in the control group. The «unsatisfactory» immediate outcomes were recorded at 10.8±2.17 units, corresponding to 17.9% of the total effectiveness.

Throughout the study, the dynamics of immediate treatment outcomes exhibited variability. On the 3rd postoperative day, only «satisfactory» (63.3%) and «unsatisfactory» (36.7%) results were observed, primarily due to the absence of clear signs of MS regression against the background of GERD. However, by the 7th postoperative day, the distribution of performance indicators for conventional LLGR spanned all levels of assessment.

Only 2 (3.3%) patients demonstrated complete resolution of GERD symptoms, absence of postoperative complications, and significant improvements in clinical and laboratory markers of MS (blood pressure, glycemia, and dyslipidemia). Unfortunately, in the remaining 58 (96.7%) patients, such results were not observed. In 78.4% of cases,

postoperative complications persisted, and clinical and laboratory markers of MS remained uncorrected against the background of GERD, while in 11 (18.3%) patients, deterioration in their condition was noted.

A similar trend was observed in the early postoperative period among patients in the control group by the 14th postoperative day. «Excellent» outcomes were recorded in only 10% of cases. Although the proportion of «good» outcomes more than doubled ($p<0.05$), the proportion of «satisfactory» and «unsatisfactory» results remained substantial, accounting for nearly half of the control group (43.4%).

Even by the 30th postoperative day, the proportion of «satisfactory» results remained the highest among all categories, exceeding «excellent» outcomes by 1.9 times ($p<0.05$) and «good» outcomes by 2.2 times ($p<0.05$). At the same time, another 3 (5%) patients continued to demonstrate «unsatisfactory» immediate treatment results following conventional LLGR, attributed to the emergence of new postoperative complications against the persistence of MS and GERD symptoms.

The analysis of average scores throughout the postoperative period revealed that on the 3rd day after conventional LLGR, the score was 2.63±0.46 points, which was 1.9 times lower than the maximum permissible value.

Over the subsequent postoperative period, this indicator showed an upward trend, reaching 3.1±0.52 points by the 7th day, which was 1.6 times below the maximum permissible score.

By the 14th postoperative day, the mean score for immediate treatment outcomes had risen to 3.55±0.71 points ($p<0.05$), and by the 30th day, it reached 3.67±0.81 points ($p<0.05$), which remained 1.4 times below the permissible maximum score.

All 60 patients underwent reassessment in the long-term postoperative period at 3, 6, and 12 months to evaluate the effectiveness of MS treatment against the background of GERD following conventional LLGR.

The assessment of bariatric surgery outcomes in the long-term postoperative period using the BARROS-1 scale is particularly noteworthy, as it enables tracking the dynamics of weight loss in terms of %EWL (Table 6).

Table 6

Dynamics of body weight changes in control group patients in the long-term period following conventional LLGR

Criteria	Dynamics of the study in the postoperative period					
	3 months		6 months		12 months	
	n=60	Scores	n=60	Scores	n=60	Scores
The set of BMI is higher than the initial one	0	0	0	0	0	0
%EWL (0-24)	52	0	31	0	0	0
%EWL (25-49)	8	8	21	21	18	18
%EWL (50-74)	0	8	8	16	25	50
%EWL (75-100)	0	0	0	0	17	51

As shown in Table 6, on average, 3 months after the use of conventional LLGR, the weight loss of patients in the control group (86.7%) was mainly at the level of %EWL (0-24), that is, it actually had no significant changes relative to the baseline data. In the remaining cases (13.3%), weight loss was relatively pronounced, at the level of %EWL (25-49). A total of 8 (4.4%) of the possible maximum points were scored, which accounted for an average of 0.13 points per patient.

However, by 6 months following conventional LLGR, the weight loss dynamics became more pronounced, although the majority of patients in the control group (51.7%) experienced weight loss at the %EWL level of 0-24. In other cases, excess weight loss reached %EWL levels of 25-49 in 35% of patients and 50-74 in 13.3% of patients. The total score amounted to 37 points, representing only 20.6% of the maximum possible value. Additionally, 11.7% of patients fell into the 1-point category, while 8.9% were classified in the 2-point category. On average, each patient in the control group scored 0.62 points for the BAROS-1 components.

Exactly one year after undergoing conventional LLGR, no patients remained in the %EWL (0-24) weight loss category, indicating that all patients experienced excess weight reduction. As the rate of weight loss increased, 30% of patients reached the %EWL level of 25-49, the majority (41.7%) achieved %EWL levels of 50-74, and 28.3% attained %EWL levels of 75-100. The total score amounted to 119 points, representing 66.1% of the maximum possible value, distributed as follows: 28.3% of patients received 3 points each, 27.8% received 2 points each, and 10% received 1 point each.

On average, 1 patient in the control group received 1.98 points 12 months after undergoing conventional LLGR.

Overall, an analysis of weight loss outcomes in patients from the control group following conventional LLGR demonstrated that only 28.3% achieved the ideal BMI, while the remaining patients were unable to reach this target despite the extended period of physiological changes. In our view, the persistence of GERD symptoms played a key role in limiting patients' progress, a factor that will be discussed in further detail.

An analysis of the BAROS-2 study results, which evaluated changes in clinical and laboratory markers of MS and GERD based on the parameters outlined in the second chapter of the dissertation, revealed a complex pattern of changes (Table 7). Over the long-term follow-up period after conventional LLGR, no deterioration in the course of MS against the background of GERD was observed. Notably, an improvement in the clinical manifestations of GERD, accompanied by enhanced laboratory parameters of MS, was detected in nearly half (46.7%) of the control

group as early as three months postoperatively. In 28.3% of patients, GERD symptoms resolved completely; however, although laboratory markers of MS showed improvement, they did not return to normal values.

Table 7

Dynamics of changes in clinical manifestations of GERD and the pathological components of MS in patients of the control group in the long-term period following conventional LLGR

Criteria	Dynamics of the study in the postoperative period					
	3 months		6 months		12 months	
	n=60	scores	n=60	scores	n=60	scores
Worsening of the course of GERD and MS	0	0	0	0	0	0
No changes in clinical signs of GERD and laboratory signs of MS	15	0	11	0	4	0
Improvement of clinical signs of GERD and laboratory signs of MS	28	28	19	19	8	8
There are no signs of GERD, the indicators of MS symptoms have improved	17	34	21	42	38	76
There are no signs of GERD or MS.	0	0	9	27	10	30

Notably, in 25% of patients, both clinical and laboratory markers of MS and GERD remained unchanged, reflecting an unsatisfactory treatment outcome. Furthermore, it is important to highlight that three months after undergoing conventional LLGR, no cases of complete resolution of GERD and MS were observed, indicating limitations in the effectiveness of this treatment approach.

On average, patients in the control group accumulated a total of 62 points, representing 34.4% of the maximum possible score, with an average of 1.03 points per patient.

Only after reaching six months postoperatively following conventional LLGR in patients of the control group did we observe the first 9 cases (15%) of complete resolution of both clinical and laboratory signs of GERD and MS. During this study period, the overall positive outcome rate remained relatively high, with 31.7% of patients demonstrating improvement in GERD and MS symptoms, while in 35% of cases, GERD manifestations resolved against the background of persistent hyperglycemia and dyslipidemia.

In 11 (18.3%) patients from the control group, clinical manifestations of GERD and laboratory indicators of MS remained unchanged at this stage. These patients continued to experience heartburn, dysphagia, and other GERD-related symptoms alongside hyperglycemia, dyslipidemia, and hypertension, even in cases where dietary adherence was maintained.

The final evaluation conducted 12 months following conventional LLGR revealed that in 6.7% of cases, despite weight reduction, no significant improvement in MS and GERD was achieved. These patients required repeated hospitalizations for corrective therapy due to worsening conditions.

Statistical analysis indicated that, on average, each patient in the control group experienced 3.2 ± 0.9 hospitalizations within 12 months following conventional LLGR. These readmissions were frequently associated with intractable vomiting, persistent heartburn, hyperglycemia, hypertension, and other complications of the underlying conditions.

The total bed days for the control group amounted to 15.6 ± 0.3, exceeding the standard benchmarks for bariatric surgery. Prolonged early postoperative recovery periods were also noted in these patients due to postoperative complications. The aforementioned case exemplifies this trend, demonstrating that early postoperative complications often extend recovery times and adversely affect long-term outcomes following conventional LLGR in patients with MS and GERD.

Additionally, in 13.3% of patients, one year after conventional LLGR, clinical signs of GERD and laboratory markers of MS showed improvement but did not reach the desired therapeutic targets.

However, in 63.3% of patients, conventional LLGR resulted in complete resolution of GERD symptoms and improvement in MS-related laboratory parameters. These patients underwent subsequent rehabilitation in endocrinological dispensaries.

Complete resolution of both clinical and laboratory manifestations of MS and GERD was achieved in 16.7% of one year post-conventional LLGR patients, a result deemed suboptimal given the expected efficacy of this surgical approach for such pathological conditions.

Twelve months post-conventional LLGR, patients in the control group collectively scored 114 points on the questionnaire, representing 63.3% of the maximum possible score. This outcome was primarily driven (42.2%) by patients who experienced resolution of GERD symptoms while showing only partial improvement in MS-related laboratory parameters. The average score per patient in the control group was 1.9 points.

Quality of life assessment using the BAROS-3 questionnaire revealed that the majority of patients reported improvement, with 48.9% indicating «got better» and 32.2% reporting «significantly better.» However, 15% of patients reported no change in quality of life, while 3.3% and 0.6% reported «worsened» and «significantly worsened» outcomes, respectively.

Table 8 presents the distribution of patient responses to the questionnaire. These findings suggest that, despite overall improvements in self-esteem, physical, social, occupational, and sexual functioning, as well as eating behavior, certain parameters remained suboptimal in a subset of patients.

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Table 8

Distribution of patients in the control group according to the results of the BAROS-3 questionnaire

The value of ratings	Number of patients by BAROS value category-3					
	S	PA	SA	WA	SA	EB
Significant deterioration	0	0	0	0	2	0
It's gotten worse	0	0	0	1	6	5
Without changes	12	7	0	4	18	13
It got better	29	28	38	29	19	33
Much better	19	25	22	26	15	9

C – self–esteem; PA – physical activity; SA – social activity; WA – work activity; SA – sexual activity; EB – eating behavior.

For example, 12 months after performing traditional LLGR, 1.7% of the surveyed patients' work activity worsened. There was also a deterioration in sexual activity (in 10% of patients) and eating behavior (in 8.3% of patients). At the same time, in 3.3% of patients, sexual activity after traditional LLGR worsened significantly.

The data on the absence of changes in the quality of life after traditional LLGR in patients with MS on the background of GERD are disappointing. It was expressed in the form of low self-esteem, still low physical (11.7%), work (6.7%) and sexual (30%) activity, as well as eating behavior (21.7%), which tends to increase weight in the future.

In general, in the context of the collected points, the most information was obtained regarding changes in social activity (20.5 points) and work activity (20 points). The lowest score was for sexual activity (9.75 points).

In general, patients in the control group scored 98 points, which was only 54.4% of the maximum possible value.

The assessment of Quality of life level using the GIQLI specific surgical questionnaire showed that patients scored 81.5 points after undergoing traditional LLGR surgery and during the examination they had the following average values: physical functioning – 23.4±4.6 points, emotional component – 16.9±3.5 points, function of the «upper» gastrointestinal tract – 16.3±4.1 points, function of the «upper» gastrointestinal tractlower» gastrointestinal tract – 18.2±3.8 points, flatulence – 6.7±1.2 points.

These data indicate the persistence of certain problems in the «upper» gastrointestinal tract, which reduced the emotional component of the quality of life of patients after undergoing traditional LLGR for the treatment of MS against the background of GERD.

In general, the unification of the long-term treatment results of patients with MS on the background of GERD in the control group who underwent traditional LLGR showed that in the period after 3 months of surgery, «satisfactory» results were achieved in 58.3% (35 patients) of cases and «good» results in 6.7% (4 patients) of cases.. Unfortunately, in 35% (21 patients) of patients, the results of surgical treatment of MS with GERD were not encouraging («unsatisfactory»).

6 months after the operation, the greater half of the patients (31 patients – 51.7%) also had «satisfactory» treatment results. The number of patients with «good» treatment results increased by 2 times compared to the previous period (11 patients – 18.3%). There were patients (3 patients – 5%) with «excellent» treatment results. However, in 15 (25%) patients, the results of traditional LLGR were still rated as «unsatisfactory».

Only 1 year after performing the traditional LLGR, the long-term results of treatment of patients changed their numerical structure. The number of patients with «excellent» treatment results increased to 17 (28.3%) cases. The indicator of «good» treatment results also increased to 41.7% (25 patients).

The frequency of «satisfactory» treatment results was 16.7% (10 patients), which was achieved by repeated hospitalization of patients to correct the identified disorders associated with both MS and GERD.

Unfortunately, in 8 (13.3%) patients, the results of using traditional LLGR turned out to be «unsatisfactory», which led to a decrease in the overall effectiveness rating of this type of BO in the treatment of patients with MS on the background of GERD.

All of the above may directly indicate the low effectiveness of traditional LLGR in patients with MS with GERD, which does not allow achieving the desired effective result due to the complex interrelationships of a number of pathological processes that exacerbate the course of the disease itself and lead to a decrease in the effectiveness of this type of surgery in the long term.

Thus, evaluation of the results of the effectiveness of traditional LLGR in patients with MS on the background of GERD revealed the presence of low values of «excellent» and «good» treatment outcomes both in the immediate (9.6% and 22.5%) and in the long-term (11.1% and 22.2%) postoperative periods of treatment due to the high incidence of postoperative complications. (in the early period, up to 1.15 units per 1 patient) and recurrence of GERD. All this required repeated hospitalizations of patients to the clinic (an average of 3.2±0.9 times) with an extension of treatment time (up to 15.6±0.3 bed days), which indicates a decrease in the patients' life expectancy while maintaining the components of MS.

The listed reasons for the unsatisfactory treatment results of patients in the control group may indicate the need for more effective solutions to the surgical problem associated with the technical side of LLGR.

The presented analysis of the results of treatment of patients with MS on the background of GERD in patients of the control group showed that even with the use of traditional methods for the formation of the antireflux position of the stomach and the elimination of hernias of the esophageal opening of the diaphragm during the LLGR, it did not lead to any significant changes in the pathology of the esophagus. In this case, we get a result regarding the treatment of MS, however, if GERD is preserved, we were unable to achieve the maximum effect from BS.

The LG modification was based on the principle of creating an anti-reflux cuff, which, along with techniques for creating an anti-reflux position of the stomach, would block the flow of gastric contents into the esophageal cavity.

This type of problem solving was based on the results of an analysis of the unsatisfactory results of using traditional LLGR.

Known methods of surgical intervention in the treatment of patients with GERD involve the implementation of Nissen fundoplication.

However, when performing LLGR, due to a decrease in the volume of the stomach, especially in its fundal part, performing such an operation is considered impossible for both anatomical and technical reasons.

In this regard, A. S. Allakhverdyan and his coauthor. (2009) proposed a new approach to the elimination of GERD by applying crurorhaphy with the creation of an anti-reflux position of the stump of the stomach. The essence of this method is to perform LLGR with mobilization of the diaphragmatic legs and the esophageal orifice of the diaphragm, performing posterior and anterior crurorhaphy with suturing in the following order: the stump of the stomach floor, the left diaphragmatic leg, the wall of the esophagus, the right diaphragmatic leg.

However, as our practice has shown, the disadvantage of this method is the development of retention of esophageal and gastric contents in the postoperative period. We also came to the conclusion that the use of crurorhaphy alone is not effective in eliminating GERD.

The objective of our proposed method was to create anatomical conditions to prevent reflux in patients with TS on the background of GERD after performing LLGR («LLGR method in patients with MS on the background of GERD» FAP № . 2610 dated 10.17.2024).

Our modified LLGR was performed as follows:

At the first stage, access to the abdominal cavity was carried out by installing trocars. After the revision of the abdominal organs, access was made to the omentum sac, with the mobilization of the stomach along the large curvature and along the gastro-diaphragmatic ligament. After installing an intragastric calibration probe 36 Fr, sleeve resection of the stomach was performed along it using a suturing device.

After reaching the hemostasis of the stapler line, anterior and then posterior crurorhaphy was performed. Next, the free part of the large omentum was mobilized on a vascular pedicle of sufficient length to be transferred to the diaphragmatic surface of the abdominal cavity. Using the mobilized part of the large omentum, a cuff was formed around the abdominal part of the esophagus. This cuff from the large omentum was tightly sewn around the abdominal part of the esophagus on a calibration probe 36 Fr.

The subsequent stages of the operation were standard: drainage of the abdominal cavity, removal of the severed part of the stomach and suturing of troacar wounds.

The optimal option for performing LLGR in patients with MS on the background of GERD is a technically feasible option for creating an antireflux position of the stomach with the formation of an antireflux cuff around the abdominal part of the esophagus due to tight stitching of the mobilized part of the large omentum on the calibration probe 36 Fr.

The modified LLGR method in patients with MS on the background of GERD was used in 60 patients (the main group). A comparative assessment of the immediate treatment results showed that, thanks to the use of our modified laparoscopic longitudinal gastric resection in patients with metabolic syndrome on the background of gastroesophageal reflux disease, it increased the frequency of «excellent» results from an average of 9.6% to 24.2% of cases, that is, 2.5 times, «good» results – from 22.5% to 42.9to reduce the frequency of «unsatisfactory» results of treatment of this disease from 17.9% to 8.3%, that is, by 1.9 times, and to reduce the frequency of «unsatisfactory» results of treatment of this disease from 17.9% to 8.3%, that is, by 2.2 times. The use of the modified LLGR method made it possible in the early postoperative period, by improving the condition of patients, to reduce the number of inpatient bed days from 16.6±3.5 to 7.2±2.2 bed days, that is, 2.3 times.

Thanks to the technical improvement of performing LPRJ with the formation of an additional cuff from a large seal, in the distant postoperative period, the overall recurrence rate of reflux esophagitis significantly decreased from 11.7% to 3.3% (t=2.482). Only in 2 observations was the development of grade 1 and grade 3 reflux esophagitis noted. Moreover, these complications occurred in patients who had grade 4 reflux esophagitis in the preoperative period (Table 9).

Table 9

Recurrence Rate of Reflux Esophagitis in Clinical Groups

Grade of Reflux Esophagitis	Control Group	Main Group	Student's t-test
1	1 (1,7±1,2%)	1 (1,7±1,2%)	0,000
2	3 (5,0±2,0%)	0 (0%)	2,513
3	2 (3,3±1,6%)	1 (1,7±1,2%)	0,828
4	1 (1,7±1,2%)	0 (0%)	1,426
Total	7 (11,7±2,9%)	2 (3,3±1,6%)	2,482

A comparative assessment of long–term treatment results showed that due to the use of our modified LLGR in patients with MS on the background of GERD, it increased the frequency of «excellent» results from an average of 11.1% to 23.3% of cases (2.1 times), «good» results – from 22.2% to 50% (2.25 times), to completely avoid cases with «unsatisfactory» results of treatment of this disease, as well as to reduce the frequency of repeated hospitalizations to the clinic by 3.9 times, and the number of beds-days – by 3 times, which indicates an improvement in the results of treatment of patients, an increase in the quality of life and a reduction in the duration of disability.

Conclusions

1. The reasons for the unsatisfactory treatment results of patients after the use of traditional laparoscopic

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longitudinal gastric resection, characterized by low values of «excellent» and «good» treatment results, both in the immediate (9.6% and 22.5%, respectively) and in the long-term (11.1% and 22.2%) periods, are the development of a high incidence of postoperative complications (up to 1.15 units per 1 patient) and recurrence of gastroesophageal reflux disease. All this required repeated hospitalizations of patients to the clinic (an average of 3.2± 0.9 times) with an extension of treatment time (up to an average of 15.6±0.3 bed days), which in turn caused a decrease in the quality of life of patients against the background of the preservation of the components of the metabolic syndrome.

2. The optimal option for laparoscopic longitudinal gastric resection in patients with metabolic syndrome on the background of gastroesophageal reflux disease is a technically feasible option for creating an anti-reflux position of the stomach with the formation of an anti-reflux cuff around the abdominal part of the esophagus by tightly stitching the mobilized part of the large omentum on the calibration probe 36 Fr.

3. The use of modified laparoscopic longitudinal gastric resection in patients with metabolic syndrome on the background of gastroesophageal reflux disease improved the results of immediate treatment results in the form of an increase in the frequency of «excellent» results from an average of 9.6% to 24.2% of cases, that is, 2.5 times, «good» results – from 22.5% to 42.9%, that is by 1.9 times, as well as to reduce the frequency of «unsatisfactory» treatment results from 17.9% to 8.3%, that is, by 2.2 times. The effectiveness of the modified laparoscopic longitudinal gastric resection made it possible in the early postoperative period to reduce the number of inpatient bed days from 16.6±3.5 to 7.2±2.2 bed days, that is, by 2.3 times.

4. The use of modified laparoscopic longitudinal gastric resection in patients with metabolic syndrome on the background of gastroesophageal reflux disease improved the results of long–term treatment results in the form of an increase in the frequency of «excellent» results from an average of 11.1% to 23.3% of cases, that is, 2.1 times, «good» results – from 22.2% to 50%, that is by 2.25 times, to completely avoid cases with «unsatisfactory» results of treatment of this disease, as well as to reduce the frequency of repeated hospitalizations to the clinic by 3.9 times, and the number of beds-days – by 3 times, which indicates an improvement in the results of treatment of patients, an improvement in the quality of life and a reduction in the duration of disability.

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МОДИФІКОВАНИЙ МЕТОД ЛАПАРОСКОПІЧНОЇ ПОДОВЖНЬОЇ РЕЗЕКЦІЇ ШЛУНКА ПРИ ХІРУРГІЙНОМУ ЛІКУВАННІ ХВОРИХ МЕТАБОЛІЧНИМ СИНДРОМОМ НА ФОНІ ГАСТРОЕЗОФАГЕЛЮ

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Резюме.

Ожиріння та метаболічний синдром також є основними факторами розвитку захворювань сердечно-судинної системи, летальність вид яких, за статистичними даними, займає перше місце. Все це свідчить про важливість проведення наукових досліджень патологій з коморбідним перебігом.

Мета дослідження. Розробка модифікованої методики лапароскопічної подовжньої резекції шлунку при хірургічному лікуванні хворих на метаболічний синдром на тлі гастроезофагеальної рефлюксної хвороби.

Матеріали та методи. Робота заснована на проведенні подвійного когортного порівняльного аналізу двох груп хворих, які були відібрані протягом 2020-2023 років. Загалом у дослідженні взяли участь 120 хворих. При цьому хворі, які перебували на

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лікуванні та обстеженні у відділенні хірургії багатопрофільної клініки Ташкентської медичної академії з 2020 по 2021 роки, склали контрольну групу, а з 2022 по 2023 роки – основну групу.

Результати та їх обговорення. У ранньому післяопераційному періоді і в подальші терміни до 30 днів динаміка зміни лабораторних показників, що характеризують прояв метаболічного синдрому, мала тенденцію до покращення. Показник глікемії натще знижувався, відбувалася нормалізація лабораторних показників дисліпідемії. При цьому зміни показників на 14-30 день післяопераційного періоду набували достовірного характеру в порівнянні з вихідними значеннями.

Висновки. Використання модифікованої лапароскопічної подовжньої резекції шлунку у хворих із метаболічним синдромом на тлі гастроезофагеальної рефлюксної хвороби дозволило покращити результати віддаленого лікування у вигляді підвищення частоти «відмінних» результатів у середньому з 11,1% до 23,3% випадків, тобто у 2,1 рази, «добрих» результатів – з 22,2% до 50%, тобто у 2,25 рази, повністю уникнути випадків з «недовольними» результатами лікування цього захворювання, а також скоротити частоту повторних госпіталізацій у клініку у 3,9 рази, а кількість ліжко-днів – у 3 рази, що свідчити про поліпшення результатів лікування хворих, підвищення якості життя та скорочення термінів втрати працездатності.

Ключові слова: гастроезофагеальна рефлюксна хвороба; хворі з метаболічним синдромом; лапароскопічна подовжня резекція шлунку; результат.

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