

liver vessels, a significant raise in the blood flow rate in the portal vein and an increase in the blood flow rate in the hepatic veins were revealed. In patients with CHD comorbid with NAFLD, an imbalance of adipocytokines was revealed: a decline in the concentration of adiponectin, an raise in the level of resistin, and a decline in the ratio of adiponectin to resistin, in comparison with the control group and with patients with CHD without liver pathology. A significant increasing in the serum level of ADMA and CRP in patients with CHD with poor ventricle pathology indicates the presence of ED against the background of activation of systemic inflammation, which may have a pathogenetic significance in the development and progression of CHD in the presence of comorbidity with NAFLD.

Key words: CHD, NAFLD, adipocytokines, resistin, endothelial dysfunction.

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The authors declare that there is no conflict of interest.

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RECONSTRUCTIVE DUODENOENTEROPLASTY IN PATIENTS AFTER STRANGULATED INTERNAL HERNIA AFTER REVISIONAL ROUX-EN-Y GASTRIC BYPASS (CLINICAL CASE)

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Bariatric surgery is the most effective method of treatment for obesity and related metabolic disorders. Bariatric surgery leads to a sustainable loss of excess body weight and compensation for comorbidities associated with obesity, primarily type 2 diabetes and cardiovascular diseases, which generally leads to a reduction in mortality. Given the growing interest in bariatric surgery, the diagnosis and surgical correction of complications after revisional operations remains an urgent challenge for surgeons, especially in the context of overweight relapse. One of the most serious and potentially life-threatening complications for patients is a strangulated internal hernia.

The surgical approach to the correction of strangulated internal hernias is quite diverse and depends on the length of the strangulated loop and its viability. On an emergency basis, in this category of bariatric patients, the surgical intervention for this complication usually implies obstructive resection of a section of the small bowel.

The use of the reconstructive duodenoenteroplasty technique allowed to restore the physiological passage of food and enzymes through the gastrointestinal tract. Normal functioning of the gastrointestinal tract after reconstruction allowed to stabilise weight, restore normal blood biochemical parameters and, as a result, improve the quality of life.

Key words: reconstructive duodenojejunal plication, Roux-en-Y gastric bypass surgery, obstructive resection, morbid obesity, recurrence of overweight, bariatric surgery.

Connection of the publication with planned research works.

The work is a fragment of the research "Complex development of innovative minimally invasive techniques in surgery with use in practical and educational programs", state registration number 0120U105160.

Introduction.

Morbid obesity is a widely recognised public health problem. Following a National Institutes of Health (NIH) conference convened in 1991, surgical approaches were recognised as the most appropriate treatment for patients with clinically significant obesity, with a body

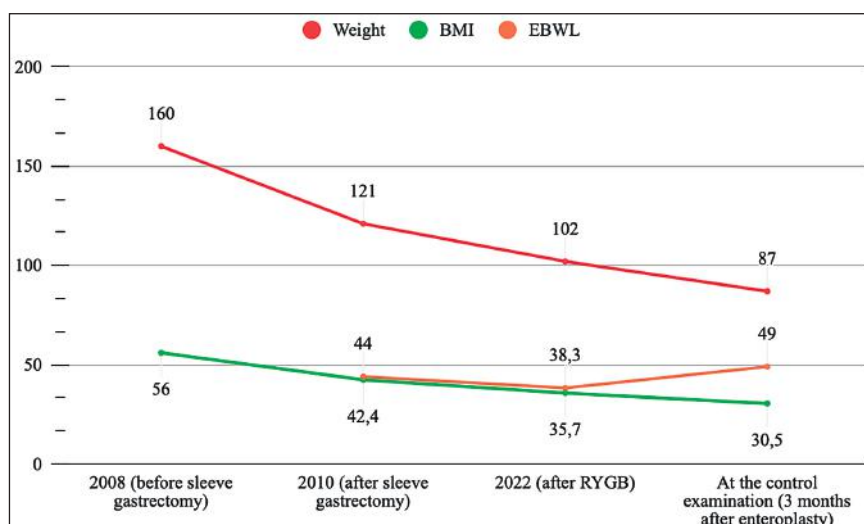


Figure 1 – Graphical representation of the dynamics of weight, body mass index and % EBWL.

mass index (BMI) greater than 35 kg/m² and associated comorbidities or a BMI greater than 40 kg/m² without associated comorbidities. The NIH conference declared Roux-en-Y Gastric Bypass (RYGB) as the gold standard among surgical techniques, providing considerable benefits for patients with morbid obesity [1, 2].

Despite all the benefits, RYGB also has its drawbacks, among which internal hernias are a significant one. Their incidence is about 5% in the long-term postoperative period. Moreover, internal hernias, through the existing “windows” in the mesentery, can lead to small bowel obstruction and the occurrence of intestinal obstruction. Most surgeons perform regular repair of defects

in the mesentery of the small bowel [3]. Thus, according to Brodin R. et al. the incidence of internal hernias is significantly reduced when the Petersen’s defect is closed [4].

At the same time, there are a restricted number of publications in the literature devoted to the surgical treatment of patients after obstructive resection of the small intestine as a result of a strangulated internal hernia after RYGB.

The aim of the study.

To evaluate the efficiency and safety of reconstructive duodenoenteroplasty in a patient after obstructive resection of the biliopancreatic loop after a strangulated internal hernia, after Roux-en-Y Gastric Bypass.

Object and research methods.

Complaints, anamnesis, results of an objective examination and data of instrumental research methods in a patient who underwent obstructive resection due to a strangulated internal hernia after revisional laparoscopic Roux-en-Y Gastric Bypass.

The study was conducted in accordance with the principles of the Declaration of Helsinki of the World Medical Association “Ethical Principles of Medical Research Involving Human Subjects” (amended in October 2013). The patient gave written informed consent to participate in the study.

Results of the study.

Patient B., 52 years old, came to the surgical department of the SSI “CIMT of the NAS of Ukraine” with complaints of general weakness, discomfort in the epigastric region and the presence of a duodenostomy.

According to the patient’s anamnesis, he underwent sleeve gastrectomy in 2008. Before surgery: Height – 169 cm, weight – 160 kg. BMI – 56.0 kg/m², IBW – 65 kg.

After the operation: weight – 121 kg, BMI – 42.4 kg/m², percentage of excess body weight loss (%EBWL) – 44.0%, percentage of total body weight loss (%TBWL) – 24.4%.

There was a steady weight loss for 14 years, but later the patient started to gain weight again. He turned to the surgical department due to a relapse of overweight, where he underwent revisional Roux-en-Y Gastric Bypass with simultaneous posterior crurorhaphy. After the operation, the patient’s parameters were as follows: weight 102 kg, BMI 35.7 kg/m², %EBWL – 38.3%, %TBWL – 15.7% (fig. 1).

After 3 months, he developed intense spastic abdominal pain and bloating after consuming excessive amounts of food and alcohol. He was taken to a surgical hospital and immediately operated for acute small bowel obstruction due to a strangulated internal hernia with necrosis of the biliopancreatic loop of the small intestine.

The following procedures were performed: laparoscopy, conversion to upper midline laparotomy, resection of the small bowel loop, gastrostomy by Witzel. A schematic representation of the scope of the operation is shown in fig. 2, the dotted line indicates the area of

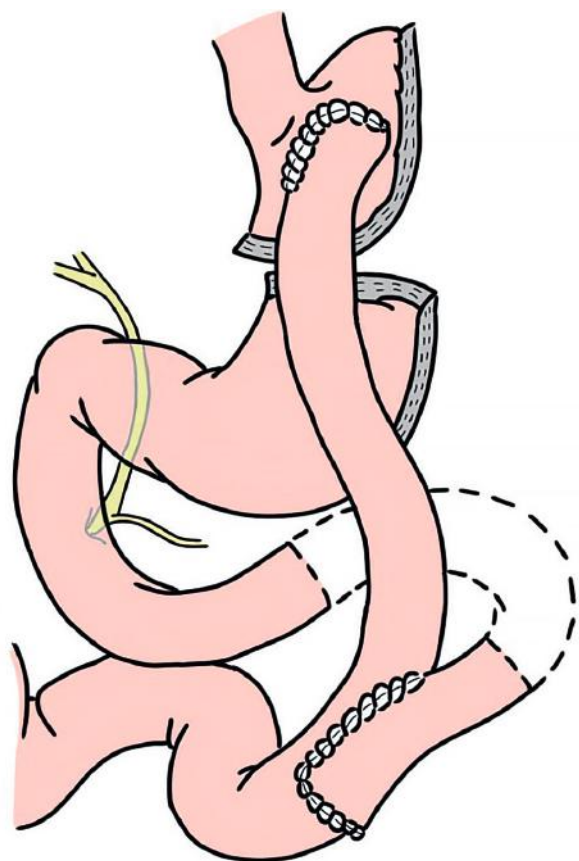


Figure 2 – Schematic representation of obstructive resection of the biliopancreatic loop.

the biliopancreatic loop of the small intestine that was removed due to necrosis. Afterwards, the gastrostomy was removed as a result of mechanical obturation and replaced with a duodenostomy under ultrasound guidance.

At the time of admission to the surgical department of the SSI "CMT of NAS of Ukraine" one and a half months after the previous surgical intervention, the weight was 100 kg, BMI was 35.0 kg/m², respectively.

Laboratory tests on presentation: Hb – 114 g/l, leukocytes – 5.93 x10⁹/l, ESR – 35 mm/h, ALT – 51.2 U/l, AST – 38.7 U/l, GGT – 54.5 U/l, ESR – 151.8 U/l, urea – 2.47 mmol/l, total protein – 69.9 g/l, amylase – 34.6 U/l, CRP – 3.0 mg/dl, folate – 9.9 ng/ml, iron – 10.7 µmol/l, ferritin – 56.0 ng/ml, Ca – 1.2 mmol/l, sodium – 140.2 mmol/l, K – 4.6 mmol/l.

Fistulography was performed. A contrast agent was injected through the nasogastric tube and duodenostomy (**fig. 3**). Visualised the terminal part of the resected stomach, the descending and horizontal part of the duodenum. The contour was clear, with a tight filling, no contrast agent leakage beyond the described area was noted.

The patient was consulted by related specialists.

Cardiologist: Essential hypertension II, grade 2, risk 3.

Endocrinologist: Obesity grade I-II. Condition after RYGB. Vitamin D deficiency.

The patient underwent reconstructive restorative duodenojejunosomy. From the operation protocol: A midline laparotomy was performed. Intraoperatively, at a distance of 75 cm, the small bowel stump (biliopancreatic loop) was visualised and resected (going to the ligament of Treitz). Access to the descending and lower horizontal parts of the duodenum was made through the great omentum. A window was formed in the right half of the mesentery of the transverse colon. The mobile part of the biliopancreatic loop was passed through the window in the mesentery to the lower horizontal part of the duodenum to the right of the Zherdi line. A side-to-side duodenojejunoanastomosis was formed (**fig. 4**). **Fig. 5** shows the general scheme of the reconstructive surgery.

During postoperative fistulography, the anastomosis was functionally preserved (**fig. 6**).

The postoperative period was complication-free. Enteral nutrition was restored from the first postoperative day according to the protocols of fast postoperative recovery.

The total bile flow rate through the duodenostomy on admission was 2-2.5 litres per day. Part of the bile (1-1.5 litres) was returned through an enteral feeding tube during meals.

In the case of a decreasing volume of bile returned orally, the patient rapidly developed a water-electrolyte imbalance, which required parenteral infusion therapy.

The patient was discharged in a satisfactory condition on the 7th postoperative day with an active duodenostomy under the ambulatory guidance of a surgeon and a gastroenterologist.

At hospital release: Hb – 113 g/l, leukocytes – 6.4 x 10⁹/l, CRP – 5.8 ml/l, K – 4.01 mmol/l,

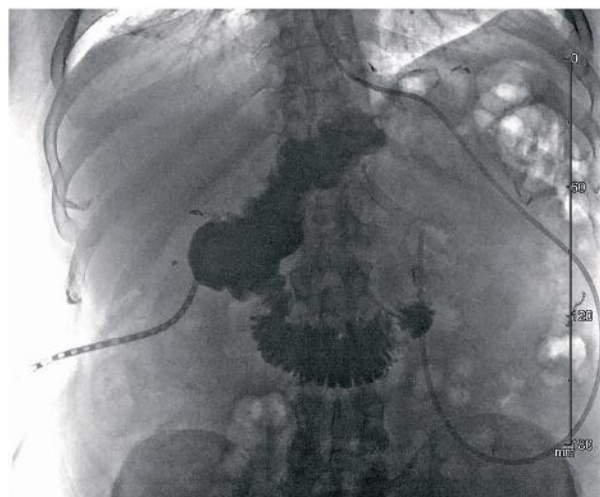


Figure 3 – Fistulography.

Na – 137.4 mmol/l, Ca – 1.23 mmol/l, total protein – 58.9 g/l, albumin – 36.5 g/l.

10 days after the operation, when the bile flow rate was less than 300 ml, the duodenostomy was removed after fractional overlap.

At the 3-month check-up, the patient showed a tendency to reduce body weight (weight 87 kg, BMI – 30.5 kg/m², %EBWL – 49%), and complete restoration of physiological nutrition.

Discussion of the study results.

Bariatric surgery has exists since the 1950s. And over the decades, it has been demonstrated that a large number of patients who undergo bariatric surgery successfully achieve a significant and sustained reduction in excess body weight. In addition, compensation for a number of metabolic disorders, such as type II diabetes and hyperlipidaemia, has been observed, so the term “metabolic bariatric surgery” (MBS) has become a better definition. In its long history, MBS has evolved from an era of high complication and mortality to an era of safety, despite remaining high risks for patients undergoing such operations [5].

Body weight loss after bariatric surgery can be explained by a decrease in food intake, an increase in energy consumption, a decrease in the availability of nutrients for intermediate metabolism (e.g., calorie malabsorption) and, as a result, altered metabolic rate or a combination of all these factors [6].



Figure 4 – Intraoperative picture of the side-to-side duodenojejunal anastomosis (reconstructive duodenoenteroplasty).

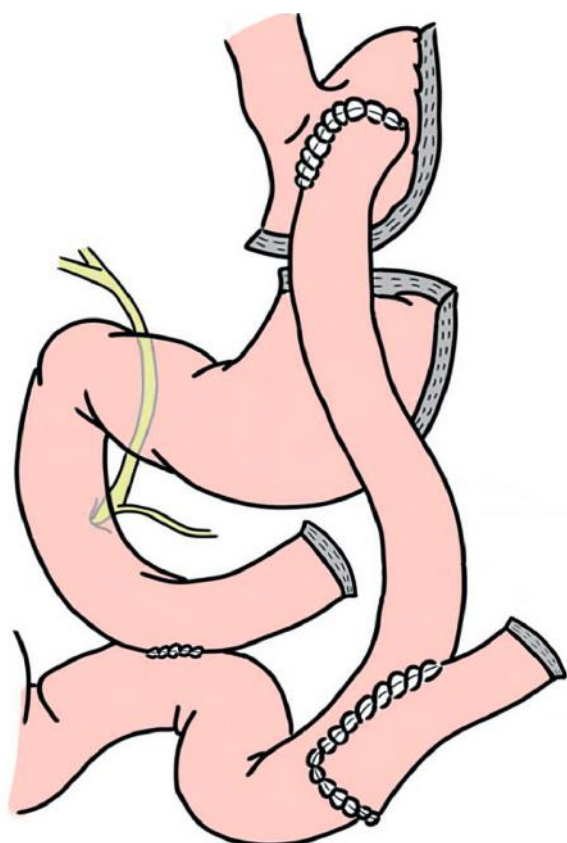


Figure 5 – Schematic representation of the reconstructive duodenoenteroplasty.

Who is typically eligible for bariatric surgery?

Patients with a body mass index of $\geq 40 \text{ kg/m}^2$ without concomitant pathology and for whom bariatric surgery will not be associated with excessive risk to health and life.

Patients with a body mass index (BMI) $\geq 35 \text{ kg/m}^2$ and one or more severe obesity-related complications that can be corrected by weight loss, including type II diabetes mellitus (T2DM), high risk of developing T2DM (insulin resistance prediabetes and/or metabolic syndrome), poorly controlled hypertension, non-alcoholic fatty liver disease/non-alcoholic steatohepatitis, obstructive sleep apnoea, osteoarthritis of the knee or hip, and stress urinary incontinence.



Figure 6 – Postoperative fistulography.

The right type of bariatric surgery should be based on individual treatment goals (e.g., weight loss and/or specific obesity-related complications), patient preferences, and personalised risk stratification that prioritises safety and its details.

Despite the technical challenges, laparoscopic bariatric surgery should be preferred over open techniques due to lower early postoperative mortality and lower risk of complications [2].

Minimally invasive techniques have become the standard approach to performing these interventions, with laparoscopic Roux-en-Y Gastric Bypass being one of the most commonly used in the world [7].

In a systematic review of the literature, Chapman et al. observed how BMI changes after various types of bariatric surgery and found that in a 4-year period after RYGB, the loss of excess weight ranged from 50% to 67% [8].

The Kaplan-Meier analysis, in its turn, showed that almost 90% of patients who underwent RYGB did not require additional bariatric surgery [9].

Despite all the advantages of RYGB, the results of large cohort studies show that the overall incidence of postoperative complications is 15-20%, and the incidence of internal hernias is about 5%. Several studies have identified a number of predictors of postoperative complications after RYGB, including high BMI, comorbidities such as diabetes mellitus, smoking, and anticoagulant medication [7, 3].

Despite a rather high percentage of complications, the mortality rate in this category of patients, according to the Bariatric Surgery Centres of Excellence, is only 0.2% [10].

Most publications have shown that the percentage of complications in the postoperative period is higher after revision surgery, although it should be noted that all these studies used preoperative weight as a baseline [11].

In fact, when performing gastric bypass, there are two methods of forming a gastroenteroanastomosis, depending on the location of the small intestine in relation to the transverse colon. This creates a number of potential defects in the mesentery, which, in turn, are a kind of “windows” for the formation of internal hernias. The retrocolic technique creates 3 defects: one in the transverse colon, one at the site of ileojejunostomy and Petersen’s defect (the space formed between the Roux-en-Y and transverse colon). The antero-colic technique creates only 2 mesenteric defects: one in the area of the ileojejunostomy and the Petersen’s defect [12].

The diagnosis of internal hernia is not always easy, because many patients present with different symptoms and some cases may be initially misdiagnosed. Patients may describe nausea and vomiting, paroxysms of pain and bloating, and an inability to consume food and fluids in complete volume. Symptoms may progress to persistent pain, decreased bowel sounds, and increased vomiting [13].

According to the literature, the time of symptoms manifestation is highly variable and can occur within one week to three years after surgery, but in most cases, manifestation occurs between 6 and 24 months after surgery [10].

It is important to mention that laboratory deviations are usually nonspecific. These changes may include de-

creased haemoconcentration and electrolyte balance due to vomiting and fluid transudation. The level of blood urea nitrogen and creatinine may increase due to pre-renal azotemia. There is also marked leukocytosis, neutrophilia, and a "left formula shift" to immature leukocyte forms in the blood test [14].

As patients often present with unclear clinical symptoms or even asymptomatic, imaging is an important component of the diagnosis. The main findings of intravenous contrast-enhanced MDCT that can help clinicians diagnose internal hernia are mesenteric rotation, "mushroom symptom," "hurricane eye," signs of small bowel obstruction, clustered looping, and others [13].

Dilauro et al. found that the presence of a sign of bowel loop rotation in patients after RYGB indicates an internal hernia even without the presence of dilated small bowel loops. Two previously unreported MDCT signs of internal hernia were also proposed: "beak" of the superior mesenteric vein (SMV) and "cross" dilation of the second-order mesenteric vessels with a change in the anatomical ratio of the SMV and superior mesenteric artery [15].

In general, MDCT plays a key role in the diagnosis with an accuracy of up to 95%, according to the study by Diamond M. et al [16].

Mesenteric defects can be closed in different ways. Most often, it is the Petersen's defect that can lead to internal hernia. The literature describes two main methods used for its closure.

The CLOSURE method, according to which the defect is sutured after a gastrointestinal anastomosis (fig. 7). First, a traction suture is placed between the small and transverse colon, and the Petersen's defect is closed with a continuous suture using V-Loc™ 3-0 suture (Medtronic VR, Minneapolis, Minnesota, USA).

The MEFIX method (mesenteric fixation method) by fixing the mesentery of the small bowel to the transverse colon (fig. 8) prevents ischaemia of the intestine, thereby preventing the torsion of the small bowel mesentery.

The transverse colon has relatively few blood vessels within 30 cm distal to the ileojejunostomy site. A traction suture is placed at the site of the beginning of the sutures, and the mesentery of the small intestine is fixed to the transverse colon using V-Loc™ 3-0 suture (Medtronic VR, Minneapolis, Minnesota, USA). It is applied from the inferior mesenteric artery to the mesenteric root, which is located in approximately 2/3 of the small intestine mesentery. Similarly, at the last stage of suturing, two or three sutures are made with V-Loc 3-0™ sutures.

According to the study by Brolin R. and co-authors, the MEFIX technique has a number of advantages:

First, fixation of the mesentery, located within 30 cm distal to the jejunojunctionostomy, to the mesentery of the transverse colon

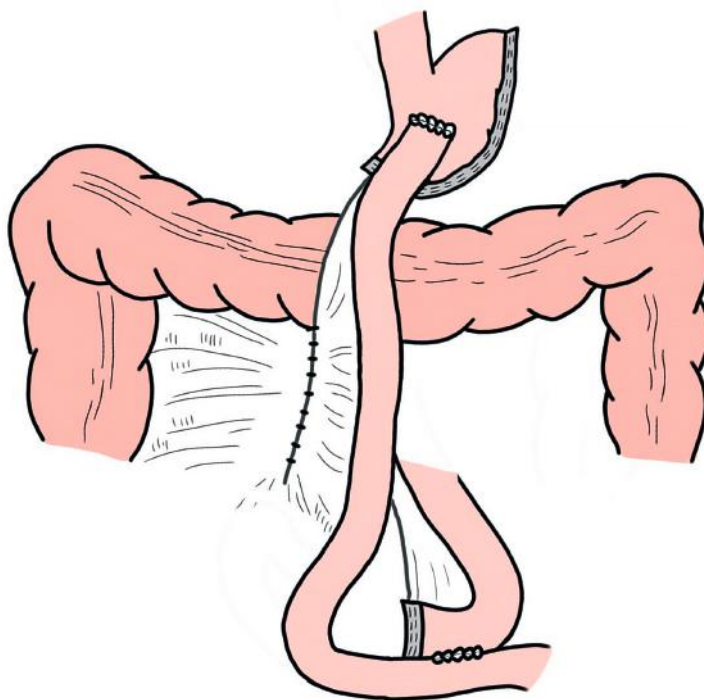


Figure 7 – Schematic representation of the closure of Peterson's defect using the CLOSURE method.

not only prevents excessive prolapse of the small intestine through the defect, but also reduces the tension applied to the jejunojunctionostomy for preventing torsion; second, the operation time can be reduced because only the middle part is sutured instead of continuous suturing from the root to the peripheral part of the mesentery; third, suturing from the root artery to the arcade artery without suturing the vasa recta of the small intestine minimises the risk of complications such as bleeding and ischaemia by reducing vascular damage [4].

In this clinical case, a patient with an internal hernia underwent obstructive resection of the entire stran-

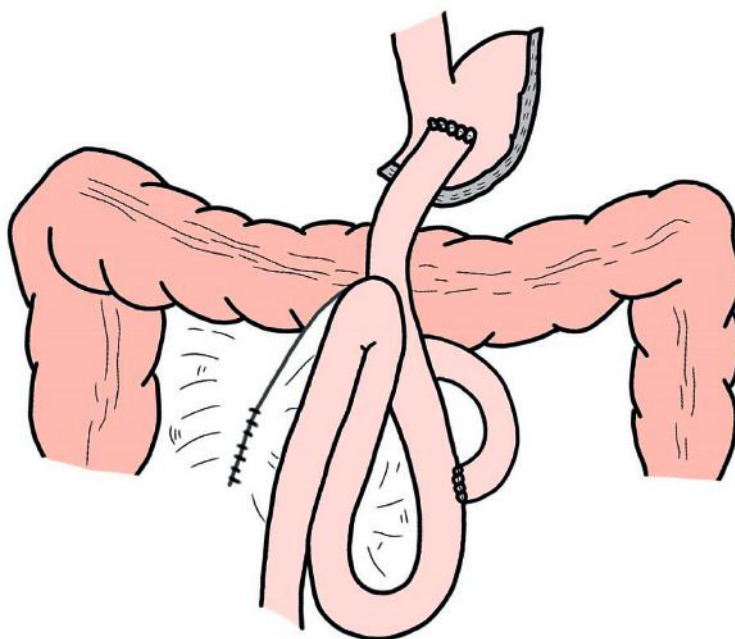


Figure 8 – Schematic representation of the variant of Peterson's defect closure using the MEFIX method.

gulated biliopancreatic loop with the formation of a duodenostomy for bile outflow. Intraoperative surgical tactics for internal hernia with the progression of small bowel obstruction were aimed at hernia repair, revision of the abdominal cavity, and resection of the ischaemic part of the intestine. This volume of surgery was aimed primarily at saving the patient's life.

No analogues of such surgical intervention were found in the literature.

Despite the patient's stable condition and normal blood tests after obstructive resection, a month later the bile flow rate through the duodenostomy was 2000-2500 ml per day. This daily bile loss rate is similar to an external duodenal fistula.

The main components of bile are bile acids, phospholipids, cholesterol and bilirubin, as well as other trace elements and ions.

It should be mentioned that the biliary function is extremely important in the body, as it is responsible for the absorption of fats in the intestine, cholesterol homeostasis and excretion of various end products of metabolism [17].

In this clinical case, based on the daily bile flow rate with subsequent possible nutritional and electrolyte disorders, and also based on the results of the preoperative examination, it was decided to perform reconstructive duodenoenteroplasty to restore the normal physiological process of nutrition and digestion.

Conclusions.

Reconstructive duodenoenteroplasty is an effective and safe method of reconstruction after obstructive resection of the small intestine due to a strangulated internal hernia. The patient who underwent reconstructive duodenoenteroplasty demonstrated a stable dynamics of weight loss during the observation period, restoration of enteral nutrition and improvement of quality of life.

Perspectives for further research.

A large-scale multicentre prospective study would be very useful to objectify the effectiveness and importance of this method in the treatment of patients after obstructive small bowel resection as a result of a strangulated internal hernia after Roux-en-Y Gastric Bypass.

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РЕКОНСТРУКТИВНА ДУОДЕНОЕНТЕРОПЛАСТИКА У ПАЦІЄНТІВ ПІСЛЯ ЗАЦЕМЛЕНОЇ ВНУТРІШНЬОЇ ГРИЖІ ПІСЛЯ РЕВІЗІЙНОГО ШУНТУВАННЯ ШЛУНКА ЗА РУ (КЛІНІЧНИЙ ВИПАДОК)

Калашніков О. О., Усенко О. Ю., Тодуров І. М., Косюхно С. В., Пилипчук О. О.

Резюме. Зростання проблеми ожиріння займає вагомe місце в сучасному суспільстві та підкреслює необхідність розробки ефективних та довгострокових підходів до її вирішення. Баріатрична хірургія стала важливим компонентом лікування ожиріння і відкриває пацієнтам нові можливості для покращення здоров'я та якості життя. Ревізійні операції, у свою чергу, надають можливості для оптимізації результатів попередніх баріатричних втручань при незадовільній втраті або рецидиві надлишкової маси тіла. Хоча ці операції й спря-

мовані на досягнення кращого результату в лікуванні ожиріння, вони також пов'язані з ризиком виникнення певних післяопераційних ускладнень, серед яких внутрішня грижа є складним і потенційно небезпечним. Защемлена внутрішня грижа, зокрема, через ішемізацію кишки, виникнення тонкокишкової непрохідності та інших важких ускладнень, потребує невідкладного втручання, а саме обструктивної резекції. Для пацієнтів, які перенесли подібне хірургічне втручання, відновлення нормальної анатомії та забезпечення фізіологічного пасажу їжі по шлунково-кишковому тракту є вкрай важливим, і цю мету можна досягти за допомогою реконструктивної дуоденоентеропластики. У цій статті ми описуємо застосування реконструктивної дуоденоентеропластики, виконаної у пацієнта, який переніс обструктивну резекцію через защемлену внутрішню грижу після ревізійного лапароскопічного шунтування шлунка за Roux-en-Y.

Ключові слова: реконструктивна дуодено-ентеропластика, ревізійне шунтування шлунка за Ру, рукавна резекція шлунку, резекція білопанкреатичної петлі, рецидив маси тіла.

RECONSTRUCTIVE DUODENOENTEROPLASTY IN PATIENTS AFTER STRANGULATED INTERNAL HERNIA AFTER REVISIONAL ROUX-EN-Y GASTRIC BYPASS (CLINICAL CASE)

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Abstract. The growing problem of obesity is a significant issue in modern society and emphasises the need to develop effective and long-term approaches to its solution. Bariatric surgery has become an important component of obesity treatment and opens up new opportunities for patients to improve their health and quality of life. Revisional surgeries, meanwhile, provide opportunities to optimise the results of previous bariatric interventions in case of unsatisfactory weight loss or recurrence of an excessive body weight. Although these surgeries are aimed at achieving better results in the treatment of obesity, they also carry the risk of certain postoperative complications, among which the internal hernia is a complicated and potentially dangerous one. A strangulated internal hernia, in particular, due to bowel ischaemia, small bowel obstruction and other severe complications, requires urgent intervention, such as an obstructive resection. For patients who have undergone such surgery, restoring normal anatomy and ensuring physiological passage of food through the gastrointestinal tract is extremely important, and this goal can be achieved with reconstructive duodenoenteroplasty. In this article, we describe the use of reconstructive duodenoenteroplasty performed in a patient who underwent obstructive resection due to a strangulated internal hernia after revisional laparoscopic Roux-en-Y Gastric Bypass.

Key words: reconstructive duodenojejunal plication, Roux-en-Y gastric bypass surgery, obstructive resection, morbid obesity, recurrence of overweight, bariatric surgery.

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