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Surgical treatment of acute cholecystitis in obese patients

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ABSTRACT:

Introduction: In today's technological climate, science and medicine have entered a new era. At the level of technological progress, we have identified millennia of "new" problems and diseases. If earlier diseases had a certain individuality then, in the third millennium, we face compliance and synergistic influence of diseases. Obesity is a problem of the third millennium. It is known that obesity is the main factor in the development of various chronic diseases [1–3]. With excess weight and obesity, bile is oversaturated with cholesterol, resulting in an increase of its lipogenicity index. As a result, frequency of gallstone disease increases; findings from this study document an increase of disease frequency as high as 50% to 60% [4]. In 20% of patients, housing concerns are combined with obesity [5]. Thus, obesity is one of the factors in the development of cholelithiasis and cholecystitis [6]. The presence of acute cholecystitis represents the most difficult situation for patients with gallstones. When obesity is also present, the patient's risk of surgical complications increases due to altered homeostasis and reduced reserve capacity [7]. A retrospective study of this issue [8] posed a number of questions about the possibility of influencing the course of disease in the preoperative period as well as the improvement and impact of surgical technicalities in patients with acute cholecystitis and obesity. Addressing these and additional questions is the main goal of this study.

Aim: The aim of the study was to study and select the optimal method of surgery in patients with acute cholecystitis and obesity.

Materials and methods: In our study, a prospective analysis was used. We analyzed 67 cases with diagnosis of acute cholecystitis and obesity; all were treated at Kyiv Regional Clinical Hospital in the period from September 2018 to March 2020. Patients with acute cholecystitis and obesity received either traditional or modified laparoscopic cholecystectomy.

Results: Retrospective analysis indicates traditional laparoscopic cholecystectomy is technically difficult and costly in patients with acute cholecystitis and obesity. A modified laparoscopic cholecystectomy has been proposed to improve and enhance surgery in patients with acute cholecystitis and obesity. Surgical duration was shortened by 9.01 ± 0.41 minutes ($p = 0.001$; $\alpha \leq 0.05$) when a modified laparoscopic cholecystectomy was performed.

Conclusions: Performing a modified laparoscopic cholecystectomy reduced the duration of surgery by 9.01 ± 0.41 minutes ($p = 0.001$; $\alpha = 0.05$), prevents development of metabolic acidosis pH 7.39 ± 0.03 vs 7.30 ± 0.005 = 0.001; $\alpha \leq 0.05$, pCO_2 5.05 ± 0.36 vs 6.03 ± 0.38 ($p = 0.02$; $\alpha \leq 0.05$), reducing the risk of hypercoagulation. Modified laparoscopic cholecystectomy (LHE) is effective in II and III degrees of obesity ($p = 0.001$; $\alpha = 0.05$).

KEYWORDS: acute cholecystitis, laparoscopic cholecystectomy, obesity

ABBREVIATIONS

BMI – body mass index
CI – confidence intervals
LHE – laparoscopic cholecystectomy
XE – cholecystectomy

INTRODUCTION

In today's technological climate, science and medicine have entered a new era. At the level of technological progress, we have identified millennia of "new" problems and diseases. If earlier diseases had a certain individuality then, in the third millennium, we face compliance and synergistic influence of diseases. Obesity is a problem of the third millennium. It is known that obesity is the main factor in the development of various chronic diseases [1–3]. With excess weight and obesity, bile is oversaturated with cholesterol, resulting in an increase of its lipogenicity index. As a result, frequency of gallstone disease increases; findings from this study document an increase of disease frequency as high as 50% to 60% [4]. In 20% of patients, housing concerns are combined with obesity [5]. Thus, obesity is one of the factors in the development of cholelithiasis and cholecystitis [6]. The presence of acute cholecystitis represents the most difficult situation for patients with gallstones. When obesity is also present, the patient's risk of surgical complications increases due to altered homeostasis and reduced reserve capacity [7].

A retrospective study of this issue [8] posed a number of questions about the possibility of influencing the course of disease in the preoperative period as well as the improvement and impact of surgical technicalities in patients with acute cholecystitis and obesity. Addressing these and additional questions is the main goal of this study. The aim of the study was to study and select the optimal method of surgery in patients with acute cholecystitis and obesity.

MATERIALS AND METHODS

In our study, a prospective analysis was used. We analyzed 67 cases with diagnosis of acute cholecystitis and obesity; all were treated at

Kyiv Regional Clinical Hospital in the period from September 2018 to March 2020. The study included patients who initially applied to the hospital. The exclusion criteria included the following: patients with chronic or exacerbation of chronic cholecystitis; younger than 18 years of age; did not have the full range of studies; patients with mechanical jaundice, including those with cancer and uncompensated chronic diseases; patients with body mass index (BMI) of 25.0–29.9 kg/m². Diagnosis of acute cholecystitis was confirmed by ultrasound. All patients underwent anthropometry. Height (meters [m]), weight (kilograms [kg]), and abdominal circumference (centimeters [cm]) were measured. In addition to obesity as a concomitant pathology, patients with acute cholecystitis recorded data on the presence of the following comorbidities: hypertension, diabetes, and dyslipidemia. Upon admission, all patients underwent a general blood test, biochemical and immunological analysis, blood pressure reading, electrocardiography, and chest X-ray. Patients with acute cholecystitis and obesity received either traditional laparoscopic cholecystectomy or modified laparoscopic cholecystectomy. The essence of the modified surgery was to place an additional 5th trocar in the left hypochondrium, in the projection of the Mayo-Robson's point, adherence to the six safe steps (Tokyo Protocol) for surgical treatment of acute cholecystitis as recommended in 2018 by the Delphi consensus in Tokyo, and reducing intra-abdominal pressure from a range of 15 millimeters of mercury (mm Hg) to 17 mm Hg to 0.0 mm Hg every 30 minutes with hyperventilation for one minute. The installation of the 5th port at the Mayo-Robson's point is necessary for the introduction of a laparoscopic retractor (blade or proverbial gold finger) while improving the plane of surgery and the amplitude of manipulation of instruments. According to a retrospective study, results of surgical treatment and postoperative complications were considered. All removed gallbladders were subjected to histological examination which revealed the types of acute cholecystitis.

The obtained data were statistically processed by Exel 2010 and Statistica 10 software programs using the descriptive method of relative, absolute numbers, standard deviations, and their errors. The correlation between variables was studied using the Pearson's test ($\chi 2$). Testing the significance of the difference between the two independent groups was performed using Student's t-test.

RESULTS

In patients with acute cholecystitis and obesity, according to the results of retrospective analysis, the performance of traditional laparoscopic cholecystectomy is technically difficult and costly. A modified laparoscopic cholecystectomy has been proposed to improve and enhance surgery in patients with acute cholecystitis and obesity. To refute or confirm this hypothesis, two groups were randomly selected among patients with acute cholecystitis and obesity. The first group, consisting of 35 patients, included persons who underwent modified laparoscopic cholecystectomy (LHE) (experimental). In the second group of 32 patients, traditional LHE (control) was performed.

Modified LHE involves several stages. The first stage is the construction of the 5th port at the Mayo-Robson's point. According to the Tokyo Protocol, the next step is to follow six safe steps for surgical treatment of acute cholecystitis, which reduces the likelihood of damage to the choledochus. If at least one of the six steps is not possible, further surgery threatens to damage the common bile duct and encourages conversion (the need to switch to open surgery).

Tab. I. Peculiarity of LHE in patients with acute cholecystits and obesity.

CHARACTERISTIC	MODIFIED LHE (N = 35)	TRADITIONAL LHE (N = 32)	P
Duration of surgery (minutes)	75.16 ± 5.72	84.17 ± 5.31	0.001
Conversion rate (n, %)	2 (5.71%)	3 (9.38%)	0.05
Damage of common bile duct (n, %)	0 (0%)	1 (3.13%)	0.05

Note: p > 0.05 = no statistical difference

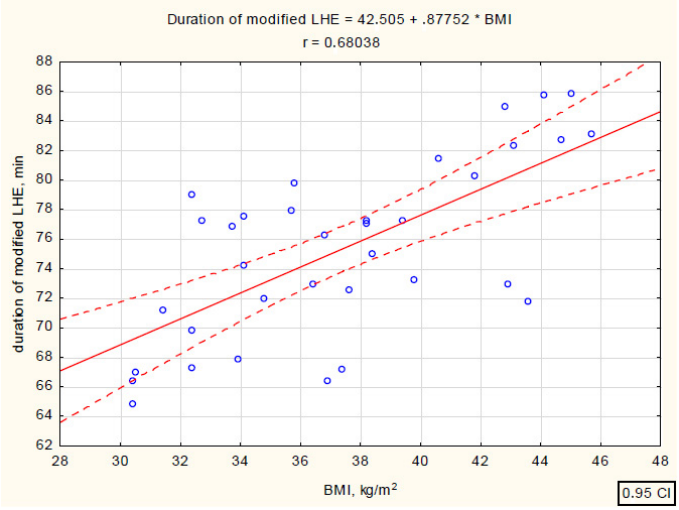

Fig. 1. Duration of modified LHE depending on BMI.

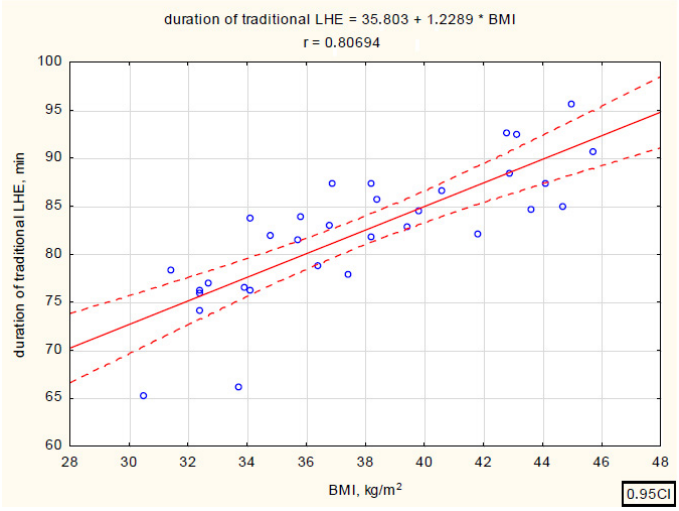

Fig. 2. Duration of traditional LHE depending on BMI.

Performing a modified laparoscopic cholecystectomy reduced the duration of surgery by 9.01 ± 0.41 minutes (p = 0.001; α = 0.05) (Tab. I.).

When dependence of surgical duration on BMI was compared between the two study groups (Fig. 1., 2.), a strong correlation between

Tab. II. Comparison of the duration of surgery depending on the method and degree of obesity in patients with acute cholecystitis.

BMI COMPARISON GROUP	AVERAGE VALUE SUBGROUP 1	AVERAGE VALUE SUBGROUP 2	?	P	N SUBGROUP 1	N SUBGROUP 2	SD SUBGROUP 1	SD SUBGROUP 2	F
I dg_1 vs I dg_2	71.63692	75.60636	-1.84866	0.077993	13	11	4.896687	5.626952	1.320510
I dg_1 vs II dg_2	**71.63692**	**83.16091**	**-6.73386**	**0.000001**	**13**	**11**	**4.896687**	**3.101211**	**2.493113**
I dg_1 vs III dg_2	**71.63692**	**88.58500**	**-8.71380**	**0.000000**	**13**	**10**	**4.896687**	**4.233250**	**1.338002**
II dg_1 vs I dg_2	74.23800	75.60636	-0.61068	0.548649	10	11	4.510121	5.626952	1.556574
II dg_1 vs II dg_2	**74.23800**	**83.16091**	**-5.32693**	**0.000039**	**10**	**11**	**4.510121**	**3.101211**	**2.115017**
II dg_1 vs III dg_2	**74.23800**	**88.58500**	**-7.33465**	**0.000001**	**10**	**10**	**4.510121**	**4.233250**	**1.135086**
III dg_1 vs I dg_2	**81.13200**	**75.60636**	**2.37653**	**0.028144**	**10**	**11**	**4.959870**	**5.626952**	**1.287081**
III dg_1 vs II dg_2	81.13200	83.16091	-1.13580	0.270166	10	11	4.959870	3.101211	2.557867
III dg_1 vs III dg_2	**81.13200**	**88.58500**	**-3.61436**	**0.001983**	**10**	**10**	**4.959870**	**4.233250**	**1.372754**

Note: subgroup 1 = modified LHE, subgroup 2 = traditional LHE

the two variables was identified (r1 = 0.68038 compared with r2 = 0.80694; p = 0.001; α = 0.05).

Based on the correlation-regression analysis of the dependence of the two variables and taking into account the correction, the coefficients of determination R21 = 0.4466 compared to R22 = 0.6395 were determined; p = 0.001. This finding indicates that, from 95% confidence intervals (CI) to 19.29% CI, modified LHE reduces the variability of the duration of surgery from BMI. The frequency of conversions of surgery in the group of modified LHE decreased by 1.6 times compared to the traditional method of surgery but these indicators do not have a statistically significant difference (p = 0.05).

The duration of surgery in patients with acute cholecystitis and obesity has a multifactorial effect. Tab. II. combines two factors: the method of surgery and the degree of obesity according to BMI. There is no statistical difference (p = 0.078; α = 0.05) in patients with grade I obesity regarding the duration of surgery, regardless of the method of surgery. At the II degree of obesity, we note a decrease in the duration of surgery by 8.92 minutes (p = 0.001; α = 0.05), while in patients with III degree, the duration of the operation decreases by 7.45 minutes (p = 0.001; α = 0.05). Thus, the implementation of the modified LHE is effective in the II and III degrees of obesity.

Modified LHE involves several stages. According to the Tokyo Protocol, one of the stages is to follow six safe steps that reduce the probability of damaging the common bile duct (Fig. 3.).

Step 1.: If an overstretched gallbladder interferes with adequate examination during surgery, it is necessary to perform decompression by fine-needle aspiration (Fig. 3A.);

Step 2.: Effectively performed retraction of the gallbladder outlines the area in the Kalo triangle and creates a contour of the boundaries (Fig. 3B.);

Step 3.: Start dissection begins from the posterior area of the gallbladder for gallbladder exhibition of Riviera slot (Fig. 3C.);

Step 4.: Maintain the plane of dissection during surgery (Fig. 3D.);

Step 5.: Dissection of at least one-third of the lower part of the gallbladder creates a critical safety review (Fig. 3D.);

Step 6.: Perform a critical safety review (Fig. 3E.).

If at least one of the steps is not possible, further surgery threatens damage to the common bile duct and encourages conversion.

It should be noted that intra-abdominal pressure during traditional laparoscopic cholecystectomy in obese patients was 15 mm Hg to 17 mm Hg. However, given the duration of surgery, constant maintenance of intra-abdominal pressure in the range of 16 mm Hg to 17 mm Hg can cause metabolic acidosis and promote the development of hypercoagulation, which increases the risk of thrombosis (Tab. III.). In order to prevent these complications with modified LHE, a decrease in intra-abdominal pressure of up to 0.0 mm Hg was performed every 30 minutes and hyperventilation was performed for one minute. In the preoperative period two hours before surgery, injections of low molecular weight heparins at a dose of 4,000 anti-Xa (0.4 milliliter) were initiated and continued in the postoperative period.

DISCUSSION

The results of treatment of patients with GC and obesity are an important public health issue. Widespread introduction of minimally invasive methods of treatment (laparoscopic, endoscopic, puncture under guidance of ultrasound) of patients with GC has changed treatment tactics. Laparoscopic cholecystectomy is now considered the gold standard for treating patients with

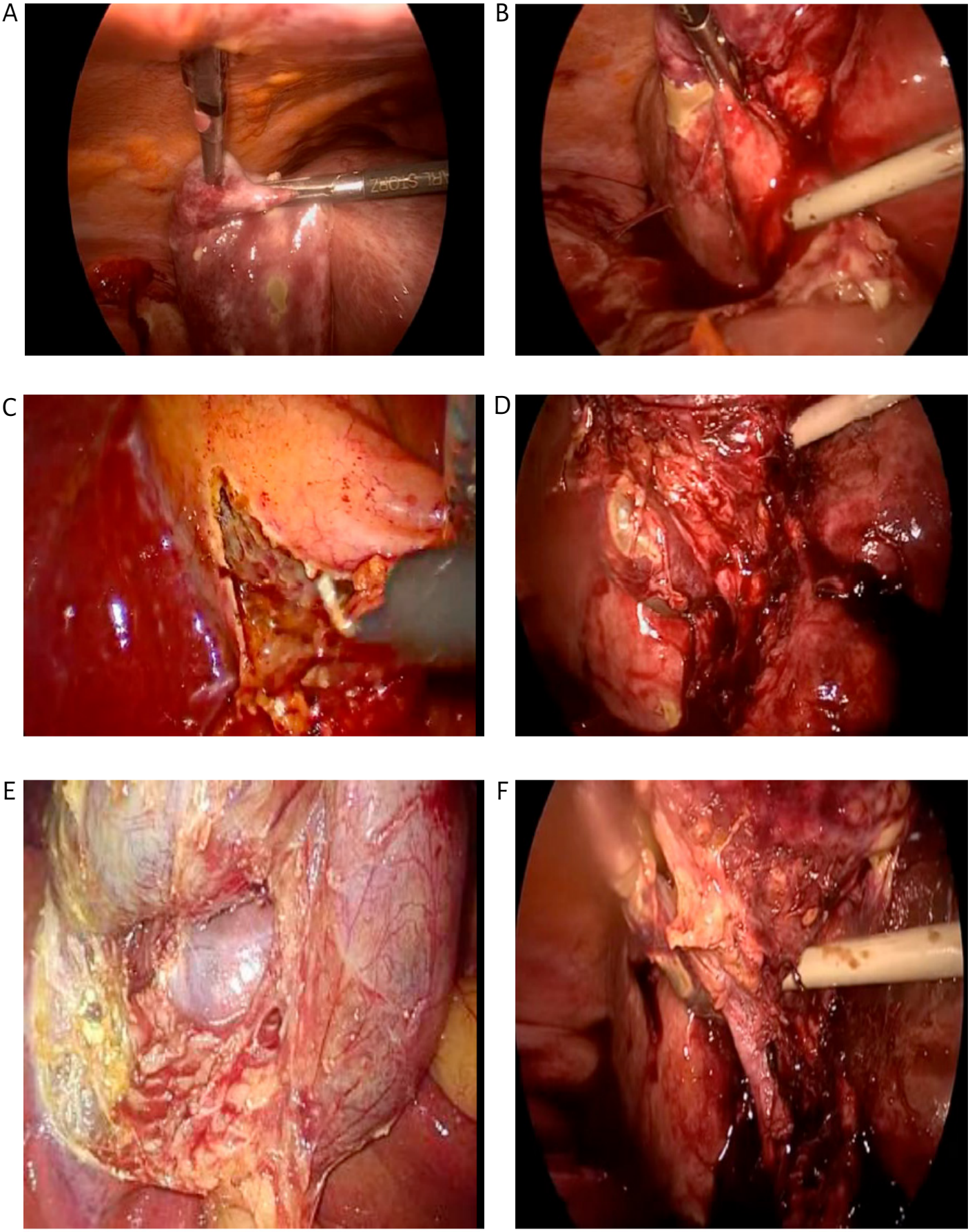

Fig. 3. Safe steps of laparoscopic cholecystectomy.

symptomatic cholecystitis [9]. The advantages of laparoscopic intervention are considered to be a small autopsy, which provides a good cosmetic effect; less pronounced pain in the postoperative period; short-duration inpatient treatment; rapid rehabilitation of the patient; and a small percentage of complications [10–12]. However, in 5% to 10% of patients whose interventions are started laparoscopically, there is a need to switch to open surgery (conversion) [13, 14]. Conversion is indicated by problems in the formation of pneumoperitoneum, the presence of adhesions in the abdominal cavity, complex anatomy in the area of the triangle Kahlo, and/or the inability to sufficiently perform traction of the bottom of the gallbladder due to enlarged fatty liver [15]. If the transition to open cholecystectomy (XE) is due to inflammatory and anatomical changes in the projection of the gallbladder and subhepatic space, laparoscopy is considered a diagnostic procedure and conversion is considered the next step. Many publications have noted that a high score on the BMI in patients with GC does not affect the results of LHE, including the transition to open surgery [16, 17]. Instead, some researchers are more inclined to perform conversion XE in patients with GC and obesity, explaining the decision to do so on the presence of complications [12, 18, 19].

Obesity in patients with GC influences certain features of surgical treatment. Previously, obesity was considered a contraindication to LHE but now LHE is the main method of treatment of patients with GC and obesity [20]. However, in obese patients, XE lasts longer. The duration of surgery is influenced by many factors: BMI; gallbladder wall thickness; the presence of perivesicular abscesses; and the complete lack of visualization of the common bile duct, which is associated with the risk of iatrogenic damage. At LHE, this indicator fluctuates within 0.2% to 1.1% [21–23]. Many meta-analyses and critical reviews of surgical safety and preventive measures were performed. The Delphic Consensus 2017 identified recommendations for safe laparoscopy: 1 – effective refraction of the gallbladder, 2 – always receive a critical safety review, 3 – avoid excessive use of electrocoagulation and cliché, 4 – Kalo triangle as the main landmark, 5 – the presence of stones in the bile duct (including Mirizzi syndrome), and 6 – severe fibrosis in the Kalo triangle. These recommendations require a change in surgical tactics [24]. In Tokyo in 2018, the Delphi consensus was declared the approved protocol for surgical treatment of acute cholecystitis [25].

Tab. III. Coagulogram and blood gas parameters in patients with acute cholecystitis and obesity in the early postoperative period.

CHARACTERISTIC	MODIFIED LHE (N = 35)	TRADITIONAL LHE (N = 32)	P
Fibrunogen (g/l)	3.16 ± 0.63	3.64 ± 0.72	0.004
Protrombin index (%)	91.02 ± 3.57	91.74 ± 3.52	0.4
pH	7.39 ± 0.03	7.30 ± 0.005	0.001
pCO_2 (kPa)	5.05 ± 0.36	6.03 ± 0.38	0.02
HCO_3- (mmol/l)	21.43 ± 0.90	20.17 ± 1.19	0.001

Note: p > 0.05 = no statistical difference

Thus, the topic of acute cholecystitis raises many questions for scientists today. The safety of surgical intervention comes to the fore, especially as this issue remains relevant in obese patients.

CONCLUSIONS

Performing a modified laparoscopic cholecystectomy reduced the duration of the operation by 9.01 ± 0.41 minutes (p = 0.001; α = 0.05) and prevents development of metabolic acidosis pH 7.39 ± 0.03 vs 7.30 ± 0.005 = 0.001; α = 0.05. pCO25.05 ± 0.36 vs 6.03 ± 0.38 (p = 0.02; α = 0.05), thereby reducing the risk of hypercoagulation. Modified LHE is effective in II and III degrees of obesity (p = 0.001; α = 0.05).

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