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Original Article

A personalized approach to the treatment of patients with mechanical jaundice of non-tumor origin

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ABSTRACT

Gallstone disease (GD) is one of the most common gastroenterological diseases and is usually detected already at the stage of stone formation. This study aimed to develop personalized surgical tactics, taking into account the stage of the disease, for patients with cholelithiasis manifested by mechanical jaundice, thereby improving treatment results. Laparoscopic cholecystostomy was more often used in patients with mechanical jaundice when choosing biliary drainage. It was found that laparoscopic cholecystectomy remains the most common operation performed for calculous cholecystitis and mechanical jaundice, which is accompanied by external drainage of the choledochus according to 20.8% of cases (according to Piskovsky technique) and in 11.4% of cases (according to Keru technique). The use of a scheme for choosing a method of treatment for MJ at different stages allows for reducing the number of complications by 9.7% to 4.6%; in the group of operations after ERCP, EPST – from 5.4% to 4.3%, with external drainage of choledochus – from 17.9% to 10%.

Keywords: Gallstone disease, Mechanical jaundice, Complications, Lethality

Introduction

Gallstone disease (GD) is one of the most common gastroenterological diseases and is usually detected already at the stage of stone formation [1]. It is most often found in women [2]. In Europe, the incidence of this disease ranges from 3 to 12% [3]. The cause of mechanical jaundice (MJ) in 30-70% of cases is GD, and in 15-30% – oncopathology [4, 5]. Surgical operations performed at the height of jaundice are accompanied by a large number of complications and the mortality rate reaches 15-30%, which is several times higher than in cases when intracurrent hypertension is resolved before surgery [6, 7]. However, the question of choosing a method of decompression of the bile ducts is still debatable, since both one-stage and two-stage methods of biliary decompression lead to the progression of liver failure. To this day, laparoscopic cholecystectomy remains the most frequently performed operation for calculous cholecystitis and MJ, accompanied by various options for drainage of the choledochus [8, 9]. However, there is a group of patients with a somatically burdened history, including those with diseases of the bronchopulmonary system, who are unable to tolerate pneumoperitoneum or general anesthesia [10]. For such patients, it is necessary to consider the possibility of performing a low-traumatic operation using a modified mini-access. Literature data show that from 2 to 15% of laparoscopic cholecystectomies are converted into open surgery during surgery for various reasons [11-13].

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To date, the topic of continuing unsatisfactory results of diagnosis and treatment of mechanical jaundice remains relevant [14, 15]. Notably, the ways to reduce the level of complications and mortality directly depend on improving the diagnosis and effective assessment of the severity of patients [16]. Some recent studies have evaluated the outcome of treatment of patients with MJ by improving the effectiveness of diagnosis and developing an accurate, individualized assessment of the severity of patients [17, 18]. It is worth noting that differentiation of the stages of the course of MJ of non-tumor genesis makes it possible to personalize the surgical and conservative treatment of such patients and, as a result, to reduce mortality and the number of complications [19, 20]. Is the two-stage surgical treatment option common in practice, which involves low-traumatic decompression of the biliary system and radical surgical intervention, the most effective? Indeed, several authors mention the existence of disadvantages of this approach [21-23]. Therefore, the issue of treatment of MJ of non-tumor origin remains unresolved.

Thus, this study aimed to develop personalized surgical tactics, taking into account the stage of the disease, for patients with cholelithiasis manifested by mechanical jaundice, thereby improving treatment results.

Materials and Methods

During the period 2010-2019, 537 patients were admitted to the hospital surgery clinic of the Kabardino-Balkarian State University named after Kh. M. Berbekov. Most of them (277 people) were admitted a week after the onset of the disease. One hundred and twenty-three (22.9%) people were admitted within a month and later from the onset of the disease. Other patients were admitted at different periods of the disease. When dividing patients by gender, it was found that 301 (56.1%) people were women. Fewer men were admitted: 236 (43.9%) people. The ratio of women to men in all groups was comparable and corresponded to the standard distribution, reported by other authors [24, 25]. The vast majority of patients were over 60 years old: 207 people (38.5%). The number of young people under the age of 30 was 43 (8%) people. There were 5 (0.9%) people aged 18 and 19 among them. Notably, there were also 49 (9.1%) people over the age of 80. The study provided for the division of all patients with MJ into two groups. The first (control) group included 249 patients who were admitted in the period 2010-2014. The average age of these patients was 64±5 years. In this group, the stages of jaundice were not taken into account when choosing treatment tactics. The second (experimental group) included 288 patients who have been admitted to the clinic since 2015. The average age of these patients was 65±5 years, which is comparable with the first group. When choosing the management tactics for these patients, different options were explored, while taking into account the stage of MJ.

The majority of patients with MJ concomitant disease had generalized atherosclerosis, which was observed in 412 patients (76.7%). Coronary heart disease occurred in 284 (52.9%) patients, hypertension – in 99 (18.4%), obesity – in 85 (15.8%), and diabetes mellitus – in 30 (5.6%) patients. Other concomitant diseases were significantly less common: kidney diseases were detected in 39 (7.3%) patients, stomach diseases – in 27 (5%), liver diseases – in 21 (3.9%), lungs diseases – in 23 (4.3%), and intestines diseases – in 11 (2%) [26]. Various types of hernias were observed in 14 (2.6%) patients and post-thrombophlebitis syndrome in 9 (1.7%) patients. A combination of two concomitant diseases was observed in 64 (12%) patients, three – in 33 (6.1%), four – in 21 (3.9%), and five – in 10 (1.9%) patients. Choledocholithiasis with MJ without concomitant diseases occurred in 111 (20.7%) people.

The clinical and laboratory picture of GD complications manifested by MJ is diverse [27, 28]. Therefore, when classifying diseases of this origin according to ICD-10, it may even be difficult to encrypt due to a wide range of root causes [29]. Pronounced symptoms of yellowing of the skin and sclera, urine, and fecal discoloration occurred in the majority of patients admitted (332) patients. In 190 patients (35.4%), skin and sclera pigmentation was not intense [30]. Only 15 (2.8%) patients had no symptoms of icteric skin and sclera. In such cases, only dark urine and discolored feces were observed [31]. All 537 patients in non-tumor MJ underwent various minimally invasive interventions draining the biliary tract. The technique of performing endoscopic retrograde cholangiopancreatography (ERCP) was performed using an Olympus TJF-30 fibrogastoduodeno scope with an outer tube diameter of 12.5 mm, an operating channel of 4.2 mm, and lateral optics. For this, 0.035-inch 7-8.5 Ch (5-11 cm) conductors were used. In endoscopic papilla sphincterotomy (EPST), arc (string length 2.0 cm) and end papillotomas were used. Extraction catheters (balloon dilators) with a diameter of 5 Ch and a length of 260 cm were used for manipulations in the ducts. For external drainage of bile, MTW endoscopy nasobiliary drains, 3 Ch plastic biliary, and pancreatic stents were used. The length of the conductor was 220 cm. After ERCP and EPST, 412 (76.7%) patients underwent nasobiliary drainage of the bile ducts with drains up to 220 cm long. Plastic biliary and pancreatic stents MTW endoscopy 3-5 Ch, 5 cm long (pancreatic), and 7-11 cm (biliary) were used for stenting. Percutaneous transhepatic retrograde external drainage of the bile ducts was performed according to the recommendations of the European Society of Gastrointestinal Endoscopy [32]. In such cases, for puncture and external bile drainage, the following were used: a Chiba 18-22 fn needle, a soft conductor with a J-shaped tip measuring 0.035 inch, and a hard conductor 0.035–0.038 inch. Bougie 7-10 fn was used to expand the puncture canal. Direct decompression of the bile duct was carried out by 8-10 fn drainage of the pigtail type. This operation was performed under local anesthesia. The novocaine infiltration included the entire abdominal wall, the liver capsule, and the liver tissue underneath. The choice of the optimal localization of the external opening was further clarified using ultrasound [33]. Rendezvous method of drainage of the biliary tract was used in 11 (2%) cases [34].

Laparoscopic cholecystostomy was performed under visual control using an Olympus video endoscopic stand [35]. The

puncture of the gallbladder was performed through the edge of the liver, the drains had a cuff fixing the drainage in the lumen of the gallbladder [36]. After decompression of the biliary tract, 500 (93.1%) patients underwent various surgical interventions. A randomized trial, a single-center, prospective, simple blind clinical trial was performed.

Statistical data processing was performed on a computer using an application software package (Word 2013, Excel 2013, Statistica 12.0). Since the distribution of values in the samples differed from the normal one, nonparametric analysis methods were used for statistical processing. The nonparametric Mann-Whitney criterion (U) was used as a criterion for the reliability of the difference between two independent groups. To compare the median features for each group, the median criterion for independent samples with pairwise comparison was used. Hypotheses about the same distribution of traits and the equality of their medians in different groups were rejected for all traits with a significance level of 0.05 and a confidence interval of 95%. There were no significant Spearman rank correlations at a level of less than 0.05 with a value of more than 0.8 modulo both within groups and across all data.

Results and Discussion

In the clinic, since 2010, all patients were first decompressed by the gall tree in various ways. The majority of biliary decompressions are represented by ERCP and EPST, 412 (76.7%) studies were completed with nasobiliary drainage of choledochus **(Table 1)**.

Table 1. The nature of decompression minimally invasive interventions performed for MJ of non-tumor origin

Types of endoscopic interventions	Number	Complications	Lethality
ERCP, nasobiliary drainage	412 (76.7%)	28 (6.8%)	3 (0.7%)
ERCP, stenting	56 (10.4%)	–	–
Percutaneous transhepatic drainage	39 (7.3%)	2 (5.1%)	–
Ante- and retrograde drainage (Rendezvous)	15 (2.8%)	1 (6.7%)*	–
Laparoscopic cholecystectomy	15 (2.8%)	1 (6.7%)*	1 (6.7%)*

* –Difference is statistically significant ($p < 0.05$)

Stenting was performed less frequently after ERCP and EPST – 56 (10.4%) cases. Percutaneous transhepatic cholangiostomy (PTC) was performed in 39 (7.3%) patients. In 15 (2.8%) patients, it turned into a Rendezvous technique involving ante- and retro-grade drainage of the bile ducts. In emergency cases, 15 (2.8%) patients underwent laparoscopic cholecystostomy. Postoperative complications after ERCP and EPST developed in 28 (6.8%) patients, which led to mortality in 3 (0.7%) cases. The fatal complication after laparoscopic cholecystostomy was associated with the severity of the underlying pathological process in the gallbladder and bile ducts [37-39]. In 37 (6.9%) patients, due to the severity of the condition due to concomitant diseases, minimally invasive drainage of the biliary tract remained the only intervention. In this category of patients, the severity of the anesthetic risk according to the ASA classification was grade IV and higher. In such cases, the principle of "from simple to complex" was followed, which helps to ensure the simplest and fastest decompression of the biliary system in an emergency situation [40]. Thus, laparoscopic cholecystostomy was used in 15 cases, while ERCP and EPST nasobiliary drainage were applied in 19 cases. Percutaneous transhepatic decompression of the biliary tract was rarely performed (3 cases) precisely because of its complexity and the danger of complications. **Table 2** shows the various types of surgical interventions performed in patients with non-tumor MJ.

Table 2. The nature of surgical interventions performed in calculous cholecystitis and MJ

The nature of the operation	Number	%
Laparoscopic cholecystectomy, total:	245	49%
Including after the ERCP	166	61.9%
– with drainage according to Pikovsky	51	20.8%*
– with drainage according to Keru	28	11.4%
Mini-access cholecystectomy, total:	189	37.8%
Including drainage of choledochus according to Pikovsky	116	63.1%*
– with drainage according to Keru	26	13.1%
– choledohodenostomy	41	20.7%*
– transduodenal papilla sphincterotomy and plastic surgery	6	3.0%
Laparotomy, cholecystectomy, drainage of the choledochus and abdominal cavity, total:	66	13.2%
Laparotomy after conversion	10	15.2%

Laparotomy in common purulent necrotic processes	34	51.5%*
Laparotomy, choledohodenoanastomy	22	33.3%*
Number of operations	500 (93.1%)	
Total	537 (100%)	

* – The difference is statistically significant ($p < 0.05$)

From the data presented in **Table 2**, it can be seen that laparoscopic cholecystectomy is currently the most common operation for calculous cholecystitis and MJ, it was performed in 245 cases. In another 79 (15.8%) patients, it was accompanied by external drainage of the choledochus, more often it was performed according to Pikovsky – in 51 (20.8%) cases, less often – according to Keru in 28 (11.4%) cases ($p<0.05$). Most of these patients had previously performed ERCP and EPST with extraction of concretions from ducts – 166 (61.9%) people. Mini-access cholecystectomy was performed in 189 (37.8%) patients. In the majority of operated patients (116 people), it ended with drainage of the choledochus according to Pikovsky, and in 26 (13.1%) patients – according to Keru ($p<0.05$), which is technically more difficult and less reliable, but provides high-quality decompression and control over the patency of the biliary system [41]. The blind seam of the choledochus did not overlap. In 41 (20.7%) patients, the patency of the choledochus after removal of concretions was impaired: during X-ray examination, the contrast was not completely emptied due to stricture. During the operation, concretions in the papilla were detected from the mini-access in 6 (3.0%) patients, which required transduodenal dissection and removal of the concretion. In 66 (13.2%) cases, such purulent-septic processes were detected in patients with complications of the gastrointestinal tract and pancreas during surgery, which required urgent wide laparotomy, removal of the focus of destruction, sanitation, and drainage of the abdominal cavity and retroperitoneal space [42]. In 10 (15.2%) people in this group, such changes were found during surgery for cholecystitis that they immediately required conversion– laparotomy after intraoperative diagnosis. In 34 (41.5%) cases, gangrenous cholecystitis, purulent cholangitis, peritonitis, and pancreatic necrosis were diagnosed immediately upon admission, which forced laparotomy intervention ($p<0.05$). In 22 (33.3%) patients, unfavorable conditions and technical difficulties forced them to expand and end the operation with the imposition of a cold-flow adenoanastomosis ($p<0.05$).

To analyze the effectiveness of the considered tactics for the management of patients with GD and MJ, it became advisable to compare the results of treatment methods before and after the creation of a comprehensive individualized tactic that takes into account the stages of jaundice development [43]. Previously, when choosing the final method of intervention, the emphasis has always been on minimally invasive technologies [44]. On this basis, it was decided to make up the first (control) study group from those admitted in the period 2010-2014, which included 249 patients. Since 2015 in the clinic, the tactics of managing patients with complications of GD in the form of MJ have changed: as a result of determining the stage of jaundice, the nature of preoperative preparation has changed, aimed mainly at a hepatotropic positive effect controlled by the level of transaminases in the blood. The development of clear laboratory guidelines for the state of liver tissue made it possible to determine the effectiveness of conservative treatment, clarify the timing of drainage of the biliary system, its types, timing, and types of surgical interventions, taking into account specific clinical and laboratory indicators – guidelines for stages of jaundice [45]. To personalize treatment, biliary tract drainage, and operations were classified into emergency, urgent, and planned.

In the second group, which consisted of 251 people in the first stage of MJ, called cholestasis (n = 129), decompression of the biliary tree and subsequent endoscopic cholecystectomy were practically combined: removal of the gallbladder was carried out the next day after effective removal of concretions and drainage of the choledochus because no additional treatment was required before radical intervention [46]. With the development of the second stage, hepatocytolysis (n = 93), treatment began with hepatotropic therapy, and the time interval between drainage of the biliary tree and cholecystectomy increased depending on the level of transaminases in the blood (elimination of hepatocytolysis), on average, up to 7 days.

The third stage, cholangitis (n = 36), was considered an emergency indication for surgical intervention – the same as for purulent-septic pathological processes in the abdominal cavity [47]. In this regard, patients were shown emergency decompression of the biliary tract with their sanitation with antiseptics. With the progression of cytolysis (transaminases) and markers of the purulent-septic process (leukocytosis, Kalf-Kalifa index, medium-weight molecules, circulating immune complexes) indications for emergency surgery were given "for vital indications", and in case of anesthetic contraindications, antibacterial and detoxification infusion therapy continued [48]. The data of both groups by age, gender, and concomitant diseases were comparable. The types of surgical interventions in both groups were as follows: laparoscopic, mini-access operations using the Prudkova technique, and traditional laparotomy interventions. The technical aspects of choledochotomy, methods of extraction of concretions, options for intraoperative diagnosis, and methods of drainage during laparoscopy and mini-laparotomy were similar to the data presented in **Table 2**. The time spent on each minimally invasive operation differed from each other and ranged from 45 minutes to 1.5 hours in complex cases. The access sizes for minimally invasive interventions were not comparable to wide laparotomy. The length of the laparotomy was more than 10 cm, the laparoscopic access is 3-4 punctures of the abdominal wall of 1-1.5 cm, and the mini-access is a transrectal incision 4-5 cm long. It is worth noting that the area of minimal impact of surgical manipulations due to

carboperitoneum was still the largest during laparoscopy. The least tissue injury was observed with mini-access when manipulations were performed only in the area of the gallbladder and bile ducts.

The nature of providing access for the operation of such patients was also different: with traditional laparotomy, gross stretching of tissues with hooks occurs. Carboperitoneum during laparoscopy is accompanied by irritation of the entire parietal and visceral peritoneum, depending on the volume of gas injected. Although this effect is insignificant, the diaphragm in such patients is still limited in excursions throughout the operation. During the operation, the tissues around the gallbladder and ducts are injured from the mini-access. The possibilities of examining the area of surgical action are best with laparoscopy when there is an enlarged image of the gallbladder, its vessels, bile ducts, ligament elements, as well as almost all other abdominal organs. They are the worst with mini-access. Thus, it is possible to see only the place of operation. With laparotomy, the situation may vary depending on the length and type of access. Due to the small size of the surgical area, mini-access does not affect concomitant lung and heart diseases. Other types of surgery can cause comorbid syndrome in the form of decompensation of cardiovascular diseases [49]

Thus, with any type of minimally invasive surgical intervention used to treat non-cancerous MJ, there are advantages to achieving a positive result, but there are also disadvantages [50]. The main thing is the lengthening of the intervention time in technically difficult cases and the high risk of intraoperative complications in such situations. Taking into account the possibilities of various operations and the factors of surgical aggression developing at the same time makes it possible to individualize the surgical treatment of non-cancerous MJ, depending on its stage [51].

In cholestatic jaundice, operations of choice are low-traumatic endoscopic operations that accelerate the rehabilitation process and give a good cosmetic result [52]. In such patients, in difficult technical cases requiring conversion, traditional laparotomic cholecystectomies are not contraindicated. Such patients are fully prepared for surgical intervention without hidden and obvious liver or any other insufficiency of vital organs.

In the cytolytic stage of jaundice, wide laparotomy is most dangerous, because the body's defense mechanisms are in a state of maximum tension due to latent and obvious liver failure, characterized by an increase in transaminases [53]. In such cases, laparoscopic cholecystectomy is desirable, but the best, especially against the unfavorable background of concomitant diseases, is the use of mini-access against the background of ongoing hepatotropic therapy. The argument in favor of such a choice should be the minimal effect on the cardiac and respiratory systems against the background of changes in the liver and the ease of drainage of the bile ducts. Mini-access surgery has an advantage over laparoscopic and laparotomy techniques also in cases where there are cicatricial changes in the anterior abdominal wall and adhesions in the abdominal cavity. In cholangitis, the surgical aid is of an emergency nature and, taking into account the severity of the patient's condition, can be limited only to decompression and sanitation of the bile ducts. In such cases, low-traumatic endoscopic operations are not always feasible because high-quality sanitation of a purulent focus with their help is a technically very difficult task, not feasible in all clinics, takes a lot of time, and requires good equipment with high-quality tools. In such cases, in a serious condition of the patient, it is necessary to limit oneself only to the most reliable and affordable decompression of the biliary tree – laparoscopic cholecystostomy. Since the situation is urgent, after drainage of the biliary tract, it is more rational to use traditional laparotomy, cholecystectomy, choledochotomy, and choledocholithotomy to remove the inflammatory focus for "untouchable" patients. Taking into account the principles of individualization of treatment, we have developed a scheme for choosing a method of treatment for MJ at different stages, which reflects the main criteria by which the type of surgical intervention is determined: indications, contraindications, and conditions. Usually, before surgery, they are additionally characterized by anesthesiologists by determining the severity of the patient's condition before surgery according to the ASA classification. **Table 3** provides a comparative description of complications and mortality in the analyzed groups. It should be noted that the difference in groups 1 and 2 in terms of the number of laparoscopic operations performed and their mini-access is small: 113 (45.4%) and 132 (59.9%) patients, respectively ($p>0.05$). The subgroup layout also provided numerically comparable data on the number of patients.

Table 3. Comparative characteristics of complications and mortality according to the analyzed groups

The nature of the operation	First group		Second group		Total	
	Absolute number (n= 249)	Complications (%) / Lethality (%)	Absolute number (n= 251)	Complications (%) / Lethality (%)	Absolute number (n= 500)	Complications (%) / Lethality (%)
Laparoscopic cholecystectomy, total:	113 (45,4%)	11 (9,7%)*/ 3,5%	132 (59,9%)	6 (4,6%)/ 1,5%	245 (49%)	17 (6,9%)* / 2,4%
After the ERPC	74 (65,5)	4 (5,4%) / 1,4%	92 (69,7%)	4 (4,3%) / 0	166 (67,8%)	8 (4,8%)/ 0,6%
with drainage according to Pikovsky	22 (19,5%)	4 (18,2)* / 4,5%	29 (22%)	3 (10,3%)*/ 3,4%	51 (20,8%)	7 (13,7%)*/ 3,9%
with drainage according to Kery	17 (15,0%)	3 (17,6%)* / 11,8%*	11 (8,3%)	1 (9,1%)*/ 9,1%*	28 (11,4%)	4 (14,3%)* / 10,7%*

Cholecystectomy from a mini-access total:	93 (37,3%)	10 (10,8%)* / 3,2%	96 (38,2%)	6 (6,2%)/ 4,2%	189 (66,1%)	16 (8,5%)/ 3,7%
Cholecystectomy from mini-access, drainage according to Pikovsky	88 (94,6%)	9 (10,2%)*/ 2,3%	28 (29,2)	1 (3,6%)/0	116 (61,4%)	10 (8,6%) / 1,7%
Cholecystectomy from mini-access, drainage according to Keru	4 (4,3%)	1 (25%) / 25%*	22 (22,9%)	1 (4,5%) / 4,5%	26 (13,7%)	2 (7,7%)*/ 7,7%*
Choledohodenostomy from mini-access	1 (1,1%)	0	40 (41,7%)	3 (7,5%) / 5%	41 (21,7%)	3 (7,3%)/ 4,9%
Cholecystectomy, transduodenal papilla sphincterotomy, and mini–access plastic surgery	0	0	6 (6,3%)	1 (16,7%)*/ 16,7%*	6 (3,2%)	1 (16,7%)*/ 16,7%*
Laparotomy, cholecystectomy, drainage of the choledochus and abdominal cavity, total:	43 (17,3%)	5 (11,6%)* / 4,6%	23 (9,2%)	2 (8,7%) / 4,3%	66 (13,2%)	7 (10,6%)*/ 4,5%
Laparotomy-conversion	7 (16,3%)	0	3 (13%)	0	10 (15,2%)	0
Laparotomy in purulent necrotic processes	18 (41,9%)	4 (22,2%)*/ 5,6%	16 (69,6%)	2 (12,3%)* / 6,2%	34 (51,5%)	6 (17,6%)* / 5,9%
Number of operations	18 (41,9%)	1 (5,6%)/ 5,6%	4 (17,4%)	0	22 (33,3%)	1 (4,5%)/ 4,5%
Total	249 (49,8%)	26 (11,6%)*/ 3,6%	251 (50,2%)	14 (5,6%) / 2,8%	500	40 (8,0%)/ 3,2%

* – The difference is statistically significant ($p < 0.05$)

The number of complications and their percentage have changed as a result of the personalized tactical approach. Their total number and percentages in the second group decreased approximately twofold: from 11 (9.7%) to 6 (4.6%) ($p<0.05$); in the group of operations after ERCP, EPST – from 4 (5.4%) to 4 (4.3%) ($p>0.05$), with external by drainage of choledochus – from 7 (17.9%) to 4 (10%) ($p<0.05$). The total number of cholecystectomies from mini-access was also comparable and amounted to 93 (37.3%) in group 1, and 96 (38.2%) in group 2 ($p>0.05$).

When performing cholecystectomy from a mini-access, the range and volume of surgical interventions have been wider since 2015. If in the first group external drainage of the choledochus was performed almost always: in 92 (98.9%) cases, then in the second group of mini-access operations, external drainage was performed almost 2 times less often than 50 (52.1%) cases ($p<0.05$). However, mini-access with internal drainage began to be performed more often: choledoduodenoanastomosis from mini-access was applied to 40 (41.7%) patients, and transduodenal papilla sphincterotomy, and papilloplasty from mini-access – to 6 (6.3%) patients ($p<0.05$). Laparotomy, cholecystectomy, and drainage of the choledochus and abdominal cavity were performed with purulent-inflammatory changes in the gallbladder and ducts, in the subdiaphragmatic space, pancreas, and retroperitoneum [54]. It should be noted that in the second group, the number of such patients decreased from 43 (17.3%) to 23 (9.2%) ($p<0.05$), which was explained by the improvement of tactical approaches. Moreover, as a result of conversion from the endoscopic method of surgery to laparotomy, the number of patients also decreased from 7 (16.3%) to 3 (13%) ($p<0.05$). This could not but affect the number of complications, which decreased from 5 (11.6%) to 2 (8.7%) ($p<0.05$), and no complications were observed after conversion. When comparing the groups, the mortality rates after laparoscopic cholecystectomies also decreased by about 2 times: in the first group, the total mortality was 3.5%, and in the second group – 1.5% ($p<0.05$). After performing operations from mini-access, the mortality rate at the end of the operation by external drainage decreased from 3.3% in the first group to 2% in the second group 2 ($p>0.05$). Laparotomic cholecystectomies with drainage of the choledochus and abdominal cavity were performed in the most severe patients. Therefore, the mortality rates in both the first and second groups improved slightly: they amounted to 4.6% and 4.3%, respectively ($p>0.05$). There was no lethality after the conversion. Even with the imposition of cholecystoduodenoanastomosis under unfavorable conditions of cholangitis, the lethality rate in the first group was 5.6% while there was no lethality in the second group. Types of complications and lethality in the analyzed groups are presented in **Table 4**.

Table 4. Types of complications and mortality in the analyzed groups

Types of complications	First group, total (n = 249)	Second group, individual (n = 251)			
		Cholestasis (n = 129)	Cytolysis (n = 93)	Cholangitis (n = 36)	Total
Purulent local					
Suppuration of wounds	7 (2.8%)	1 (0.8%)	3 (3.2%)	2 (5.6%)	5 (1.9%)
Phlegmon of the abdominal wall	3 (1.2%)	–	-	2 (5.6%)	5 (1.9%)
Total	10 (4.0%)	1 (0.8%)	3 (3.2%)	4 (11.1%)*	7 (2.8%)
Abdominal and retroperitoneal purulent-necrotic complications					
Postoperative peritonitis	13 (5.2%)	–	3 (3.2%)	4 (11.1%)*	7 (2.8%)
Pancreatonecrosis	8 (3.2%)	–	1 (1.1%)	4 (11.1%)*	5 (1.9%)

Thrombosis of mesenteric vessels	3 (1.2%)	–	–	1 (2.8%)	1 (1.9%)
Retroperitoneal phlegmon	2 (0.8%)	–	–	1 (2.8%)	2 (0.8%)
Subhepatic abscess and liver	4 (1.6%)	–	–	3 (8.3%)	3 (1.2%)
Total	13 (5.2%)	–	4 (4.3%)	9 (25%)	13 (5.2%)
Organ and systemic complications					
heart failure	7 (2.8%)	1 (0.8%)	2 (2.2%)	4 (11.1%)*	7 (2.8%)
respiratory failure	7 (2.8%)	–	1 (1.1%)	4 (11.1%)*	5 (1.9%)
violation of cerebral circulation	2 (0.8%)	–	2 (2.2%)	1 (2.8%)	3 (1.2%)
liver failure	15 (6%)	–	3(3.2%)	4 (11.1%)*	14 (5.6%)
kidney failure	3 (1.2%)	–	1 (1.1%)	2 (5.6%)	3 (1.2%)
Total	7 (2.8%)	1 (0.8%)	3 (3.2%)	4 (11.1%)	14 (5.6%)
Total with postoperative complications	26 (10.4%)*	1 (0.8%)	3 (3.2%)	9 (25%)	14 (5.6%)
Lethality	9 (3.6%)	–	3 (3.2%)	4 (11.1%)*	3 (2.8%)
Total number of patients	249 (49.8%)	156 (62.2%)	60 (23.9%)	35 (13.9%)	251 (50.2%)

* – The difference is statistically significant ($p < 0.05$)

When examining the data in **Table 4**, a wide variety of types of complications can be noted, with local purulent processes making up the smallest part of them, accounting for 10 (4.0%) cases in the control group and 7 (2.8%) in the study group ($p < 0.05$). Abdominal and retroperitoneal purulent-necrotic complications occurred with the same frequency in both groups: 13 cases, accounting for 5.2%, but in the study group they were concentrated in the group with cholangitis: a quarter of cases. Organ and systemic complications differed twofold: after the introduction of personalized tactics, they decreased from 26 (10.4%) cases to 14 (5.6%) ($p < 0.05$). The second thing that attracts attention is the shift in the number of complications in the group of patients with cholangitis, where the number of purulent local complications after the introduction of a personalized approach decreased from 7 (2.8%) cases of wound suppuration to 5 (1.9%) in the study group ($p<0.05$). In abdominal inflammatory septic processes, the number of complications decreased in persons with postoperative peritonitis from 13 (5.2%) cases to 7 (2.8%) ($p<0.05$), that is, by half. The sick part of such complications in the second group – 4 (11.1%) cases – were operated on with cholangitis. The third feature of the development of complications is damage and insufficiency on the part of all major organs and systems. Moreover, in the study group, the number of cases of such complications even increased from 7 (2.8%) to 14 (5.6%) ($p<0.05$), which is due to organ failure, again in patients with cholangitis – the most severe group that underwent surgical treatment [55, 56].

Conclusion

The personalized tactics are based on the concept of the pathogenetic development of MJ of non-tumor origin at certain stages. In the cholestatic stage of development, treatment is planned; in the cytolytic stage, it is urgent. Laparoscopic cholecystostomy was more often used in patients with mechanical jaundice when choosing biliary drainage. In ERPC, EPST with nasobiliary drainage and percutaneous transhepatic drainage, which was rarely performed due to its complexity and the risk of complications, the least number of complications and deaths were still noted in MJ of non-tumor genesis. Based on this, we believe that these methods should be more widely used in this pathology. Laparoscopic cholecystectomy remains the most common operation performed for calculous cholecystitis and MJ, which is accompanied by external drainage of the choledochus according to 20.8% of cases (according to Piskovsky technique) and in 11.4% of cases (according to Keru technique). The use of a scheme for choosing a method of treatment for MJ at different stages allows for reducing the number of complications by 9.7% to 4.6%; in the group of operations after ERCP, EPST – from 5.4% to 4.3%, with external drainage of choledochus – from 17.9% to 10%.

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