



## Differentiated Approach to Surgical Treatment of Cholelithiasis Complicated by Choledocholithiasis and Obstructive Jaundice

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### Abstract

This study contributes to solving problems of steady increase in cholelithiasis incidence with high percentage of associated complications, high mortality rate and unsatisfactory outcomes. This study rises from universally recorded increase in the incidence of gallstones, from the prevalence of complicated disease forms, from high mortality rate and unsatisfactory treatment outcomes. This study aims to improve the outcomes of surgical treatment in patients with complicated cholelithiasis who underwent a differentiated surgical intervention. This study analyses treatment outcomes in 140 patients who undergone surgery for cholelithiasis complicated by choledocholithiasis and obstructive jaundice. Patients underwent surgical interventions in a clinical unit under the West Kazakhstan Marat Ospanov State Medical University in 2014/2018. The findings show that a surgical approach towards the treatment of patients via minimally invasive surgery should depend on the severity of obstructive jaundice. Postoperative complications were found in 7.8% of patients in the main group, and the death rate was 1.1%. By contrast, in the control group, 32% had postoperative complications and the death rate was 4%. If differentiated, minimally invasive surgical treatment of cholelithiasis complicated by choledocholithiasis and obstructive jaundice allows avoiding serious complications when correcting abnormalities in the biliary system via traditional laparotomy with a wide incision. These findings suggest that a differentiated approach can significantly improve treatment outcomes in patients with cholelithiasis complicated by choledocholithiasis and obstructive jaundice.

**Keywords:** *Cholelithiasis, Choledocholithiasis, Obstructive jaundice, Endoscopic interventions.*

### Introduction

Cholelithiasis is one of the leading causes of surgical morbidity. The incidence of this pathology is between 8% and 20% in adult population. With an increase in cholelithiasis incidence, the number of associated complications also increases [1, 2]. Choledocholithiasis or gallstones in the bile duct is one of the leading complications and occurs from 8.1 to 35% of cases [3]. The incidence of jaundice resulting from obstruction of bile flow is 30-80% [3, 4].

This complication provokes the emergence of severe symptoms and requires emergency decompression of bile ducts. Traditional surgical interventions for patients with jaundice increase the risk of postoperative complications and death, which ranges from 7.2 to 45 % [5, 8].

Given this situation, modern surgical procedures involve high-tech minimally invasive treatment which provides better outcomes [9, 10]. However, various authors disagree on the optimal treatment for patients with complicated cholelithiasis and a clear algorithm to select a method for jaundice resolution, which would be appropriate for certain degree of disease severity, does not exist [11,13].

### Aim

This study rises from universally recorded increase in the incidence of gallstones, from the prevalence of complicated disease forms, from high mortality rate and unsatisfactory treatment outcomes. This study aims to improve the outcomes of surgical treatment

in patients with complicated cholelithiasis who underwent a differentiated surgical intervention.

**Material and Methods**

This study analyses treatment outcomes in 140 patients who undergone surgery for cholelithiasis complicated by

choledocholithiasis and obstructive jaundice. Patients underwent surgical interventions in a clinical unit under the West Kazakhstan Marat Ospanov State Medical University in 2014/2018. Among them, 62.1% were women (87) and 37.9% were men (53) aged 35 to 78 years. The average age was  $57.1 \pm 2.5$  years (Figure 1).

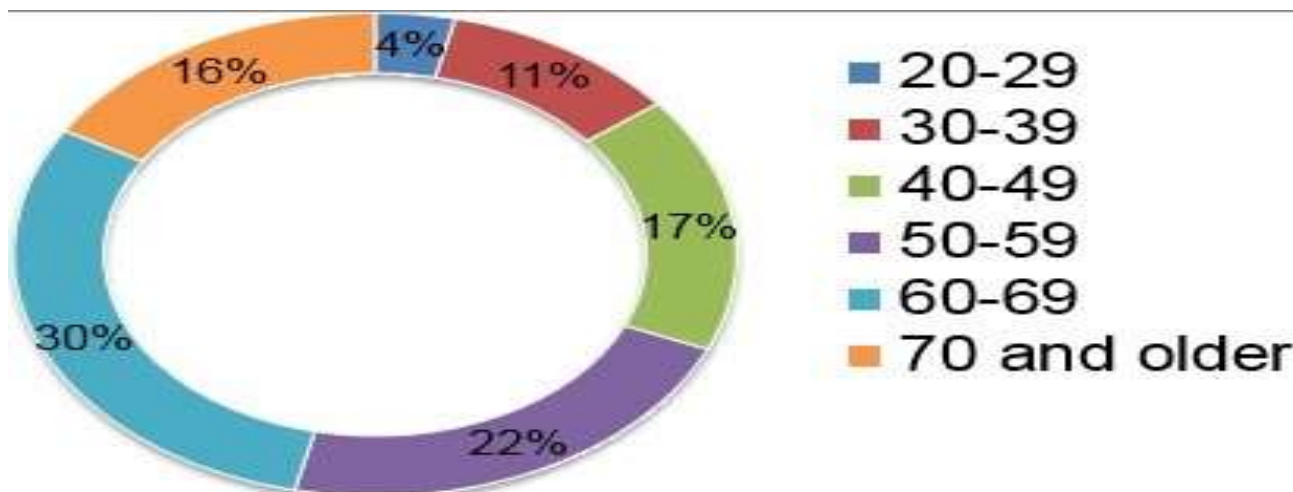


Figure 1: Proportion of patients by age

Inclusion criteria: being over 18 years old, gallstones alongside bile duct stones, complicated with obstructive jaundice. Exclusion criteria: destructive forms of acute cholecystitis complicated by peritonitis, pregnancy, being in early postpartum period, oncology, mental illness, being terminal (agonal), having open surgery before (on the upper portion of the abdominal cavity).

Disease severity assessment involves measurements, such as jaundice duration and bilirubin level, and clinical presentation of liver failure and underlying diseases. The duration of obstructive jaundice in 77 (55%) patients was less than 3 days, in 51 (36.4%) - between 3 and 10 days and in 12 (8.6%) - more than 10 days (Figure 2).

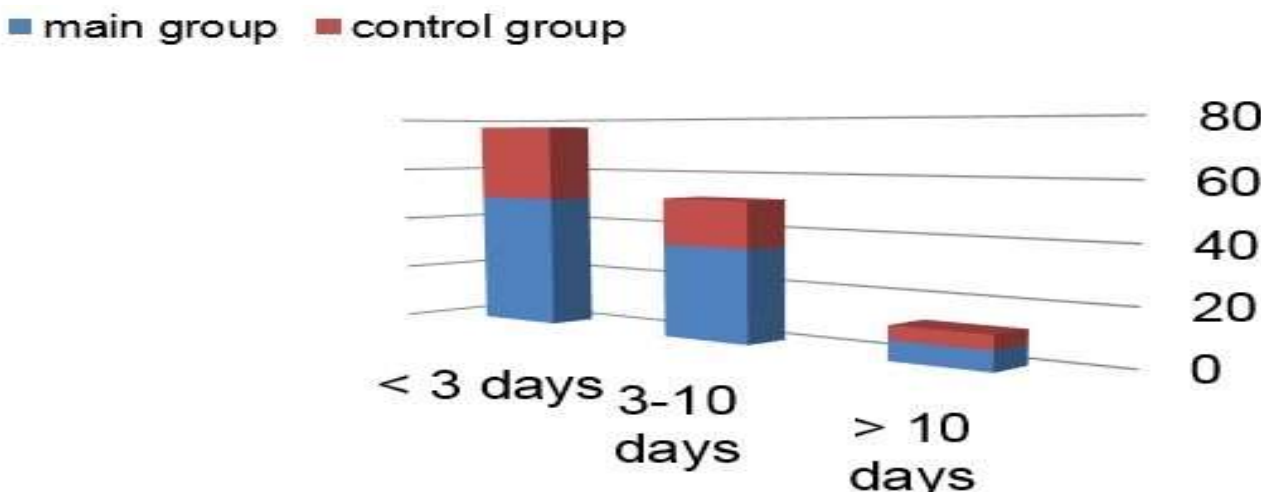


Figure 2: Duration of obstructive jaundice before hospitalization

37.8% of patients had mild jaundice, 44.2% had moderate jaundice, and 17.8% had severe conditions (Figure 3). Patients with mild jaundice (lasting less than 1 week) have total bilirubin (TB) level under  $100 \mu\text{mol/L}$ , albumin-to-globulin (A/G) ratio  $>1.2$ , and do not have neurological symptoms. Patients

with moderate jaundice (lasting more than 1 week) have TB level from  $100$  to  $200 \mu\text{mol/L}$ , some neurological symptoms, and A/G ratio  $1.2$  to  $0.9$ . Patients with severe jaundice (lasting more than 1 week) have TB level above  $200 \mu\text{mol/L}$ , some neurological symptoms, and A/G ratio  $<0.9$  [14].

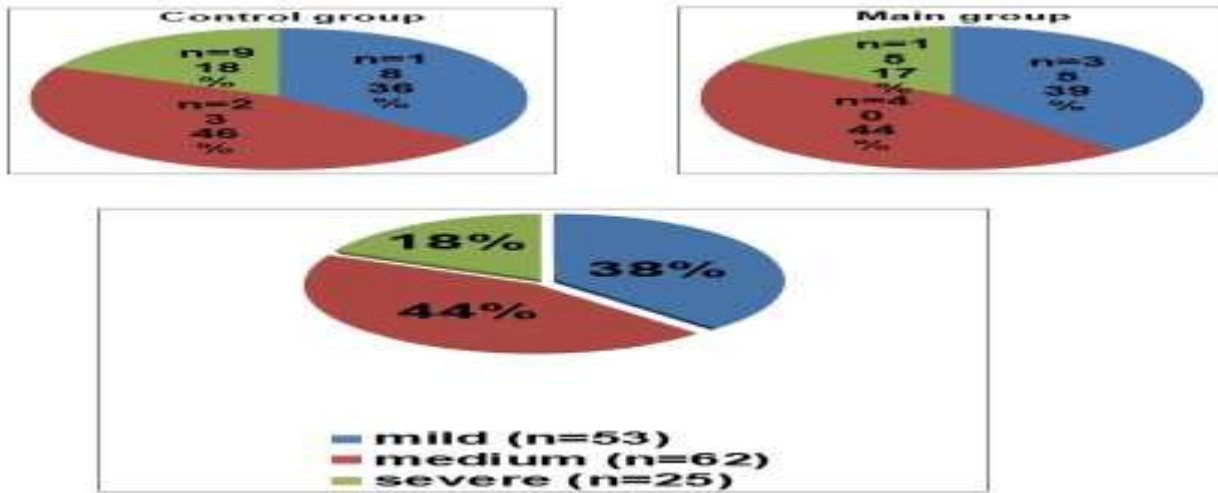


Figure 3: Proportion of patients by the severity of obstructive jaundice

Depending on surgical treatment options for complicated cholelithiasis, patients were divided in two groups. The first (main) group consists of 90 patients. This group is broken in 3 subgroups by jaundice severity.

*Subgroup 1* includes 35 mild patients. Out of them, 15 underwent LC + laparoscopic choledocholithotomy followed by external biliary drainage; 20 underwent LC + endoscopic PST followed by stone extraction.

*Subgroup 2* includes 40 moderate patients who underwent two-stage correction of biliary tract pathology: endoscopic bile duct lavage (EBDL) and on days 4 to 7, LC.

*Subgroup 3* includes 15 severe patients. Because putting severe patients to aggressive operation is not safe, drainage is the first procedure of choice if you want to remove complications and prepare your patients for subsequent radical interventions. Severe patients underwent a three-stage correction. First stage implies surgical intervention aimed at removing jaundice (nasobiliary drainage, stenting, percutaneous transhepatic biliary drainage (PTHBD).

Seven to ten days afterwards, patients underwent EPST followed by stone extraction, and 14 to 21 days later, minimally invasive cholecystectomy. Patients with pronounced infiltration and hilar adhesions underwent mini-laparotomy surgery via universal *Mini-Assistant* surgical kit

The control group includes 50 patients with contraindications to laparoscopic and endoscopic operations. In this case, EBDL is replaced by traditional cholecystectomy, followed by choledocholithotomy, transduodenal PST and by the drainage of the common bile duct (CBD) [13]. The CBD drainage is performed with T-shaped drainage tube after open choledochotomy, or with a synthetic tube to which CBD is sutured (Vishnevsky’s external drainage technique), or with a cystic duct stump.

The control group is also broken in subgroups by jaundice severity. *Subgroup 1* includes 18 mild patients, *subgroup 2-22* moderate patients, and *subgroup 3-10* severe patients. Tables below provide more details on the types and stages of surgical interventions selected for both groups.

Table 1: Surgical Tactics for Main Group (n=90)

Subgroup	Surgical Interventions	No. of Patients
<b>One-stage interventions</b>		
<b>I</b> (n=35)	LC + EPST + lithoextraction	20
	LC + laparoscopic choledocholithotomy + CBD drainage	15
<b>Two-stage interventions</b>		
<b>II</b> (n=40)	Stage 1 - EPST + lithoextraction Stage 2 - LC	35
	Stage 1 - EPST + lithoextraction Stage 2 - Mini-lap cholecystectomy using universal <i>Mini-Assistant</i> surgical kit	5
<b>Three-stage interventions</b>		

III (n=15)	Stage 1 - Stenting Stage 2 - EPST + lithoextraction Stage 3 - LC	4
	Stage 1 - Nasobiliary drainage Stage 2 - EPST + lithoextraction Stage 3 - LC	3
	Stage 1 - PTHBD Stage 2 - EPST + lithoextraction Stage 3 - LC	4
	Stage 1 - Stenting Stage 2 - EPST + lithoextraction Stage 3 - Mini-lap cholecystectomy using universal <i>Mini-Assistant</i> surgical kit	3
	Stage 1 - Nasobiliary drainage Stage 2 - EPST + lithoextraction Stage 3 - Mini-lap cholecystectomy using universal <i>Mini-Assistant</i> surgical kit	1

Table 2: Surgical Tactics for Control Group (n=50)

Subgroup	Surgical Interventions	No. of Patients
<b>One-stage interventions</b>		
I (n=18)	cholecystectomy + choledocholithotomy + T-tube drainage	6
	cholecystectomy + choledocholithotomy + Vishnevsky's drainage	11
	cholecystectomy + Холедоходуоденоанастомоз	1
II (n=22)	cholecystectomy + choledocholithotomy + T-tube drainage	7
	cholecystectomy + choledocholithotomy + Vishnevsky's drainage	13
	cholecystectomy + transduodenal PST	2
<b>Two-stage interventions</b>		
III (n=10)	Stage 1 - PTHBD Stage 2 - cholecystectomy + choledocholithotomy + drainage with cystic duct stump	2
	Stage 1 - cholecystectomy Stage 2 - cholecystectomy + choledocholithotomy + drainage with cystic duct stump	8

In both groups, medical examination methods were the same. General examination involved patient claims, medical history, blood tests, coagulation test, common urine test, hepatitis B and hepatitis C tests, blood grouping test, electrocardiography, and X-ray. Preoperative examination involved abdominal ultrasound, esophagogastroduodenoscopy, abdominal CAT and MRI scans, and endoscopic retrograde cholangiopancreatography (ERCP).

Total bilirubin, alanine aminotransferase (ALT), aspartate aminotransferase (AST) and alkaline phosphatase (ALP) were measured in blood serum on days 3, 7, and 14 after surgery. Data were processed via Student's t-test ( $p=0.05$ ) using Microsoft Excel and Statistical 6.0.

## Results

Patients with jaundice and a risk of progressing liver failure are assigned to low-

impact interventions. According to previous studies, a differentiated approach to minimally invasive treatment did not go beyond a two-step procedure (main group) and a traditional approach (control group). Besides, the severity of obstructive jaundice was not even considered [14, 18]. This research adds novelty by using minimally invasive interventions in dependence on the severity of obstructive jaundice (on the level of bilirubin and liver failure degree).

A more detailed examination and one-step procedure on biliary tract are possible in mild patients. However, this requires highly-qualified surgeons and good-quality instruments (ultrathin fiber rhinolaryngoscope and X-ray imaging system). Additionally, patients with high operational risk, moderate and severe patients, are unassignable to prolonged laparoscopic choledocholithotomy. This necessitates a three-stage procedure. In the main subgroup 2, patients had undergone

endoscopic PST, after which a Dormia basket was impacted for litho extraction to reach biliary decompression. Then, on days 4-5 after specific complications-obstructive jaundice, biliary hypertension, cholangitis, etc.-were removed, patients took LC. Five later patients (those operated on days 6-7) had pronounced infiltration and hilar adhesions, which required mini-laparotomy surgery via universal *Mini-Assistant* surgical kit.

After EBDL, 12 moderate and severe patients still had sludge (multiple small stones) in the gallbladder. To prevent it from entering CBD, a special stent was inserted. Laparoscopic procedures on biliary tract were non-possible in 9 cases, which necessitated mini-lap cholecystectomy to keep the treatment less invasive. In the control group,

32 patients underwent cholecystectomy in combination with choledocholithotomy; 11 patients underwent these procedures and transduodenal PST additionally plus 7 patients underwent additional choledochoduodenostomy.

Techniques of external biliary drainage differed between patients: 15 patients underwent drainage with a cystic duct stump, 24-Vishnevsky's drainage, 11-external T-tube drainage. After biliary decompression, patients reported on a release of pain and on the improvement in the functional status of liver. The normal bile flow was restored plus intoxication syndromes disappeared. Biochemical findings show statistically significant differences between main outcomes and controls (Table 3).

**Table 3: Biochemical Markers of Cholelithiasis**

Marker/Measurement Time		Main Group				Control Group
		Subgroup 1	Subgroup 2	Subgroup 3	Total	
Bilirubin, mmol/L	before surgery	56.9±1.47*	144.58±11.56*	290.28±13.75	171.74±11.63	197.33±15.57
	3 day	26.7±1.09*	71.35±9.14*	191.49±11.24	94.32±8.57	113.83±10.48
	7 day	15.12±0.84*	48.58±5.73*	140.64±8.07	61.44±5.08	79.38±5.03
	14 day		19.63±0.82*	56.74±6.42	29.13±2.02	33.05±1.14
Alkaline phosphatase, U/L	before surgery	139.67±9.52*	214.3±15.31*	432.4±20.06	260.52±12.65	285.7±14.74
	3 day	97.79±5.12*	183.54±10.21	330.4±17.21	201.34±11.14	221.62±12.8
	7 day	80.13±4.52*	131.73±8.17 *	278.37±14.23	150.21±7.71	165.58±8.31
	14 day		93.92±4.47*	169.14±10.06	125.13±5.36	128.57±5.65
ASAT, U/L	before surgery	85.2±3.14*	128.82±8.65*	155.56±10.15	130.84±9.68	162.08±10.78
	3 day	52.27±2.56*	83.23±5.53	89.36±5.25	75.56±5.61	92.31±5.72
	7 day	38.31±1.68*	52.82±3.37	60.54±2.96	50.63±1.63	67.17±1.07
	14 day		47.98±2.85	41.69±2.64	43.71±1.87	51.92±1.58
ALAT, U/L	before surgery	105.19±9.52*	160.27±12.31	182.99±14.34	162.27±12.43	191.44±14.01
	3 day	62.06±3.86*	121.03±9.48	139.91±10.04	101.52±7.57	127.37±8.13
	7 day	21.8±1.58*	50.44±4.13	83.01±4.14	52.35±2.03	67.65±1.91
	14 day		39.24±1.97	46.32±1.49	41.14±1.03	48.54±1.04
*Difference is significant at p < 0.05 ASAT - Aspartate aminotransferase; ALAT - Alanine aminotransferase.						

Patients in the main group improved in cholestatic and cytolytic markers faster than patients in the control group. A comparative assessment of treatment outcomes involves the incidence of postoperative complications,

average length of stay in the hospital, and death rate. Figure 4 shows that in the main group, subgroup 1 patients had stays of 6.8±1.5 days; subgroup 2 patients had stays of 10.5±1.6 days, and subgroup 3 patients –

18.6±1.8 days. In the control group, the average length of stay was 12.4±1.5 days,

16.2±1.6 days, and 24.3±1.7 days, respectively. All differences are significant at p <0.05.

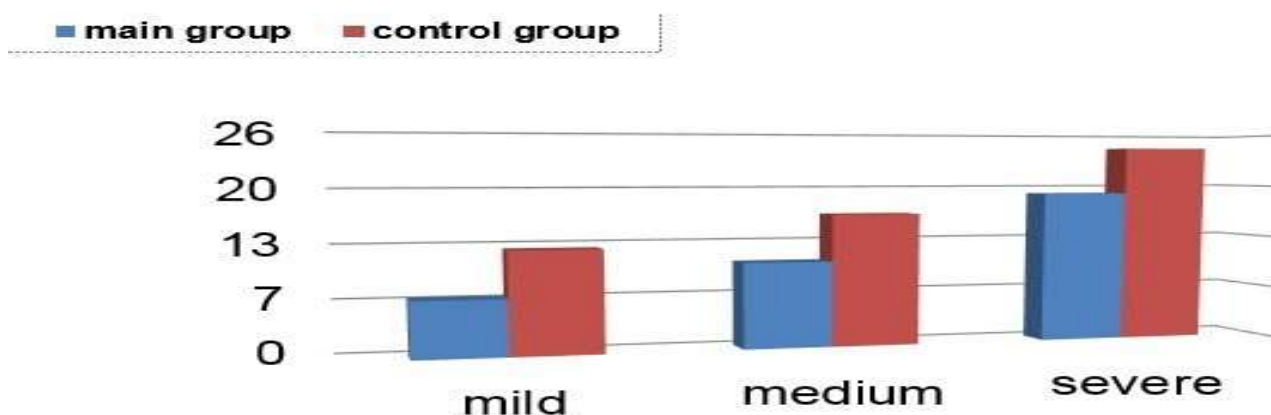


Figure 4: Average duration of inpatient treatment

Complications in patients of both groups are presented in Table 4. Complications that occurred in the main group after endoscopic PST are duodenal bleeding (occurred in 3 patients, 3.4%), and acute pancreatitis alongside amylase level rise and leukocytosis (occurred in 6 patients, 6.7%). In the first case, hemostasis was achieved by performing a periarticular injection of 0.1% solution of

adrenaline hydrochloride. In the second case, conservative treatment (contrycal 100 thousand units, sandostatin 0.1 mg 2 times a day) was successful. There was one case of damage to the terminal portion of bile duct during litho extraction. This patient was operated on the same day and discharged after recovering.

Table 4: Complications in Patients

Complications	N of Surgery Complications				
	Main Group (n-90)				Control Group (n-50)
	Subgroup 1	Subgroup 2	Subgroup 3	Total	
Duodenal bleeding	-	1	2	3	-
Acute pancreatitis	2	2	2	6	2
Damage to the terminal portion of bile duct	-	1	-	1	-
Infiltration and postoperative wound infection	-	3	-	3	9
Postoperative pneumonia	-	-	1	1	3
Bile leaj	-	1	-	1	1
Cholemic bleeding	-	-	-	-	1
Thrombophlebitis of lower extremities	-	-	1	1	-
Progressive liver failure	--	-	-	0	1
Myocardial infarction	-	-	1	1	1
Total	2	8	7	17 (18.8%)	18 (36%)

**Discussion**

In the main group, postoperative complications were found in 7 patients (incidence rate 7.8%), while the control group had 16 patients with postoperative complications (incidence rate 32%). The most frequent postoperative complications were

inflammatory infiltrates and wound infection (incidence rate 8.6%, 12 patients). Three patients had these complications after LC, due to a gallbladder, which touched the tissues in the opening area during removal. Nine cases were a result of open surgery. Postoperative pneumonia developed in 3

patients in the control group (incidence rate 6%) and in 1 patient in the main group (incidence rate 1.1%). This complication was a result of a prolonged stay in bed. Additionally, 1 patient in the main group had thrombophlebitis of lower extremities. There was 1 patient with bile leaks from gallbladder bed in both groups.

The bile leak volume did not exceed 100ml per day. The leakage stopped spontaneously on day 3-4, without a repeat surgery. One patient in the control group had cholemic bleeding (incidence rate 2%), which required relaparotomy. Postoperative mortality rate was 1.1% in the main group (1 patient died from acute myocardial infarction, which developed on the background of atherosclerosis and coronary artery disease) and 4% in the control group (1 death due to progressive liver failure, which occurred with obstructive jaundice; 1 death due to acute coronary insufficiency). Thus, if differentiated, minimally invasive surgical

treatment of cholelithiasis complicated by choledocholithiasis and obstructive jaundice allows avoiding serious complications when correcting abnormalities in the biliary system via traditional laparotomy with a wide incision.

## Conclusions

- Minimally invasive surgical treatment of patients with cholelithiasis complicated by choledocholithiasis and obstructive jaundice should be differentiated. This means that surgical approach must vary depending on the severity of obstructive jaundice.
- After endoscopic and endobiliary interventions, patients with obstructive jaundice feel better and recover faster. Moreover, these interventions contribute to the reduction in postoperative complications, from 36% to 18.8%, and mortality rate, from 4% to 1.1%.

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