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CLINICAL JUSTIFICATION OF MINIMALLY INVASIVE TECHNOLOGIES FOR BILE DUCT DRAINAGE IN OBSTRUCTIVE JAUNDICE



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МЕХАНИК САРИҚЛИКДА ЎТ ЙЎЛЛАРИНИ ДРЕНАЖЛАШНИНГ КАМ ИНВАЗИВ ТЕХНОЛОГИЯЛАРИНИ КЛИНИК АСОСЛАШ

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КЛИНИЧЕСКОЕ ОБОСНОВАНИЕ МАЛОИНВАЗИВНЫХ ТЕХНОЛОГИЙ ДРЕНИРОВАНИЯ ЖЕЛЧНЫХ ПРОТОКОВ ПРИ МЕХАНИЧЕСКОЙ ЖЕЛТУХЕ

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Резюме. *Хавфсиз механик сариқлик жиддий тиббий муаммо бўлиб, ташхислаш ва даволашга комплекс ёндашувни талаб қилади. Ушбу тадқиқотда 2015 йилдан 2024 йилгача бўлган даврда хавфсиз механик сариқлик билан касалланган 424 нафар беморни даволаш натижалари таҳлил қилинган. Асосий гуруҳни 296 нафар бемор ташкил этди, уларга каминвазив технологияларни устувор қўллаган ҳолда босқичли даволаш усулларидан фойдаланган ҳолда табақалаштирилган ёндашув амалга оширилди. Таққослаш гуруҳини анъанавий даволанган 128 нафар бемор ташкил этди. Тадқиқот давомида шуни кўрсатдики, инвазив пункцион ва эндоскопик усуллар билан биргаликда замонавий ноинвазив нур ташхис усулларини ўз ичига олган комплекс диагностика алгоритмини қўллаш асосий гуруҳдаги беморларнинг 73,64% да ўт йўлларини декомпрессия қилиш имконини берди. Допплерометрик текширувда В ва С синфидаги механик сариқликда дарвоза венасида қон оқими тезлигининг сезиларли пасайиши аниқланди. Патогенетик асосланган кам инвазив декомпрессив аралашувлардан фойдаланган ҳолда дифференциал жарроҳлик тактикасини қўллаш операциядан кейинги асоратларни 26,6% дан 19,5% гача ва ўлимни 6,5% дан 4,05% гача камайтиришга ёрдам берди. Тадқиқот натижалари яхши сифатли механик сариқлик билан оғриган беморларни комплекс даволашда каминвазив технологияларнинг самарадорлигини кўрсатади.*

Калит сўзлар: *Механик сариқлик, кам инвазив технологиялар, ўт йўлларини дренажлаш, эндоскопик папиллосфинктеротомия, тери орқали жигар орқали холангиостомия.*

Abstract. *Benign obstructive jaundice represents a serious medical problem requiring a comprehensive approach to diagnosis and treatment. This study analyzes the treatment results of 424 patients with benign obstructive jaundice from 2015 to 2024. The main group consisted of 296 patients who underwent a differentiated approach using staged treatment methods with priority application of minimally invasive technologies. The comparison group consisted of 128 patients who received traditional treatment. The study showed that the application of a comprehensive diagnostic algorithm, including modern non-invasive radiological diagnostic methods combined with invasive puncture and endoscopic techniques, allowed bile duct decompression to be performed in 73.64% of patients in the main group. Doppler studies revealed a significant decrease in portal vein blood flow velocity in class B and C obstructive jaundice. The application of differentiated surgical tactics using pathogenetically justified minimally invasive decompressive interventions contributed to a reduction in postoperative complications from 26.6% to 19.5% and mortality from 6.5% to 4.05%. The study results demonstrate the effectiveness of minimally invasive technologies in the comprehensive treatment of patients with benign obstructive jaundice.*

Keywords. *Obstructive jaundice, minimally invasive technologies, bile duct drainage, endoscopic papillosphincterotomy, percutaneous transhepatic cholangiostomy.**:** Echinococcosis of the liver, relapse, surgical treatment, closed echinococcectomy, multispiral computed tomography.*

Introduction. Benign obstructive jaundice (BOJ) remains one of the urgent problems of modern abdominal surgery, due to the significant frequency of this pathology, the complexity of diagnosis and the choice of optimal treatment tactics. According to various authors, the frequency of obstructive jaundice among surgical hospital patients ranges from 12% to 45% of all patients with hepatopancreatobiliary pathology. Despite significant achievements in the diagnosis and treatment of biliary tract diseases, mortality in obstructive jaundice remains high, varying from 4.7% to 28.5%, and with the development of liver failure reaches 40-60%.

The main causes of benign obstructive jaundice are choledocholithiasis (35-60%), bile duct strictures of various etiologies (15-30%), stenosis of the major duodenal papilla (10-20%), and chronic pancreatitis with compression of the terminal choledochus (8-15%). The development of obstructive jaundice leads to progressive liver dysfunction, development of endotoxemia, hemostasis disorders, and immunodeficiency, which significantly increases the risk of postoperative complications and fatal outcomes.

In recent decades, significant changes have occurred in the treatment of obstructive jaundice associated with the introduction of minimally invasive technologies into clinical practice. Endoscopic and percutaneous transhepatic interventions have significantly reduced the trauma of surgical treatment, decreased the number of complications, and shortened patient hospitalization periods. However, despite the obvious advantages of minimally invasive methods, a number of unresolved issues remain regarding indications for their use, choosing the optimal method of biliary decompression depending on the etiology and severity of obstructive jaundice, and determining the timing of radical interventions after preliminary biliary decompression.

Of particular importance is the study of changes in hepatic hemodynamics in obstructive jaundice of varying severity, which allows objective assessment of the functional state of the liver and prediction of the risk of postoperative complications. The use of modern Doppler ultrasound methods opens new possibilities for non-invasive assessment of portal and arterial liver blood flow, which is important for choosing optimal treatment tactics.

Thus, the development of a differentiated approach to treating patients with benign obstructive jaundice with priority use of minimally invasive technologies represents an urgent scientific and practical task, the solution of which will improve treatment results for this category of patients.

The aim of the study is to improve the results of comprehensive treatment of patients with obstructive jaundice through priority application of minimally invasive technologies.

Materials and Methods. This work was performed at the Departments of Surgical Diseases and Radiology of Samarkand State Medical University at the multidisciplinary clinic of SamSMU. The study is based on the results of comprehensive examination and treatment of 424 patients with BOJ who were in the clinic from 2015 to 2024.

All patients with BOJ were divided into 2 groups. The first main group included 296 patients treated in 2020-2024, in whom a differentiated approach was used taking into account the etiology of BOJ with staged treatment methods and priority use of minimally invasive technologies. The comparison group included 128 patients who underwent traditional diagnostic and treatment methods, as well as one-stage radical surgical interventions, treated from 2016-2020.

Among the observed patients with BOJ, there were 287 (67.8%) women and 137 (32.2%) men ($p<0.001$); in the main group - 190 (64.8%) women and 106 (35.2%) men ($p<0.001$); in the control group - 97 (75.8%) women and 31 (24.2%) men ($p<0.001$). In the main (n=30) and control (n=38) groups, 68 patients were under 30 years old, while aged 30 to 59 years there were 144 (48.6%) patients in the main group and 76 (59.4%) in the control group. Patients over 60 years old numbered 84 (28.3%) in the main group and 16 (12.4%) in the control group. Thus, the main contingent of patients with BOJ was of working age.

To assess the severity of obstructive jaundice, a classification based on total bilirubin level and presence of complications was used. Class A - mild degree (bilirubin up to 60 μmol/L), Class B - moderate degree (bilirubin 60-200 μmol/L), Class C - severe degree (bilirubin over 200 μmol/L or presence of complications).

Table 1. Distribution of patients by sex and age

Parameter	Main group (n=296)	Control group (n=128)	Total (n=424)
Sex			
Men	106 (35.2%)	31 (24.2%)	137 (32.2%)
Women	190 (64.8%)	97 (75.8%)	287 (67.8%)
Age			
Under 30 years	30 (10.1%)	38 (29.7%)	68 (16.0%)
30-59 years	144 (48.6%)	76 (59.4%)	220 (51.9%)
60 years and older	84 (28.3%)	16 (12.4%)	100 (23.6%)
Mean age	52.3±14.7	45.8±13.2	50.1±14.2

Table 2. Laboratory parameters in patients with BOJ on admission

Parameter	Main group	Control group	p
Total bilirubin, μmol/L	148.7±72.3	156.2±68.9	>0.05
Direct bilirubin, μmol/L	98.4±48.6	102.3±45.2	>0.05
ALT, U/L	156.8±84.3	162.4±79.8	>0.05
AST, U/L	142.3±76.9	148.7±72.4	>0.05
Alkaline phosphatase, U/L	486.2±198.4	498.6±204.3	>0.05
GGT, U/L	324.8±156.7	338.4±162.3	>0.05
Total protein, g/L	68.4±8.2	67.9±7.8	>0.05
Albumin, g/L	34.2±4.6	33.8±4.3	>0.05

All patients underwent comprehensive examination including clinical and laboratory research methods (complete blood count, biochemical blood analysis with determination of bilirubin, transaminases, alkaline phosphatase, gamma-glutamyltranspeptidase, total protein and its fractions, coagulogram), and instrumental diagnostic methods.

Abdominal ultrasound examination was performed on expert-class devices using convex transducers with a frequency of 3.5-5 MHz. Ultrasound assessed liver size, parenchyma structure, diameter of intra- and extrahepatic bile ducts, presence of stones in the gallbladder and bile ducts, and pancreatic condition. Doppler examination of hepatic blood flow was performed with assessment of diameter and velocity parameters of blood flow in the portal vein, hepatic artery, and hepatic veins.

Magnetic resonance cholangiopancreatography (MRCP) was performed on tomographs with a magnetic field strength of 1.5 Tesla. MRCP allowed non-invasive visualization of bile ducts, determination of the level and cause of obstruction, and assessment of liver and pancreatic parenchyma condition.

Endoscopic retrograde cholangiopancreatography (ERCP) was performed according to indications using duodenoscopes with lateral optics. When pathology of the major duodenal papilla or terminal choledochus was detected, ERCP was supplemented with therapeutic manipulations - endoscopic papillosphincterotomy (EPST), lithoextraction, nasobiliary drainage (NBD), and choledochal stenting.

Percutaneous transhepatic cholangiography (PTC) and cholangiostomy (PTCS) were performed under ultrasound and X-ray control when endoscopic interventions were impossible or ineffective.

Statistical processing of the obtained results was performed using SPSS Statistics 23.0 software package. For quantitative indicators, mean values and standard deviation (M±SD) were calculated; for qualitative indicators - frequencies and percentages. Comparison of quantitative indicators between groups was performed using Student's t-test or Mann-Whitney U-test, qualitative indicators - using Pearson's $\chi 2$ criterion. Differences were considered statistically significant at $p<0.05$.

Results and Discussion. Analysis of the etiological structure of benign obstructive jaundice showed that the most common cause was choledocholithiasis, detected in 192 (45.3%) patients. Bile duct strictures of various etiologies were diagnosed in 96 (22.6%) patients, stenosis of the major duodenal papilla in 64 (15.1%), chronic pancreatitis with compression of the terminal choledochus in 48 (11.3%) patients. Other causes (Mirizzi syndrome, liver echinococcosis, cholangitis) accounted for 5.7%. On admission, all patients showed jaundice of the skin and sclera of varying severity. Pain in the right hypochondrium and epigastric region bothered 387 (91.3%) patients, with intense pain noted in 156 (36.8%) patients. Skin itching was observed in 243 (57.3%) patients, mainly with jaundice duration exceeding 7 days. Nausea and vomiting were noted in 178 (42.0%) patients, weight loss in 134 (31.6%) patients. Laboratory studies revealed elevated total bilirubin levels in all patients. The mean total bilirubin level in the main group was 148.7±72.3 μmol/L, in the control group - 156.2±68.9 μmol/L ($p>0.05$). Increased transaminase activity was noted in 392 (92.5%) patients, alkaline phosphatase in 408 (96.2%), gamma-glutamyltranspeptidase in 384 (90.6%) patients.

Abdominal ultrasound examination revealed dilation of intrahepatic bile ducts in 396 (93.4%) patients, choledochal dilation in 378 (89.2%) patients. The mean choledochal diameter in the main group was 14.3±4.2 mm, in the control group - 14.8±4.6 mm ($p>0.05$). Choledochal stones on ultrasound were detected in 134 (31.6%) patients, which was associated with limited capabilities of the method in visualizing distal choledochal sections.

Doppler examination of hepatic hemodynamics revealed significant changes in portal and arterial blood flow depending on the severity of obstructive jaundice. In class A obstructive jaundice, the mean portal vein blood flow velocity was 18.4±3.2 cm/s, in class B - 14.2±2.8 cm/s, in class C - 10.8±2.4 cm/s ($p<0.001$). Thus, there was a 1.3-fold decrease in portal blood flow velocity in class B obstructive jaundice and 1.7-fold in class C compared to class A. Simultaneously, an increase in portal vein diameter was observed from 11.2±1.4 mm in class A to 13.8±1.8 mm in class C ($p<0.01$).

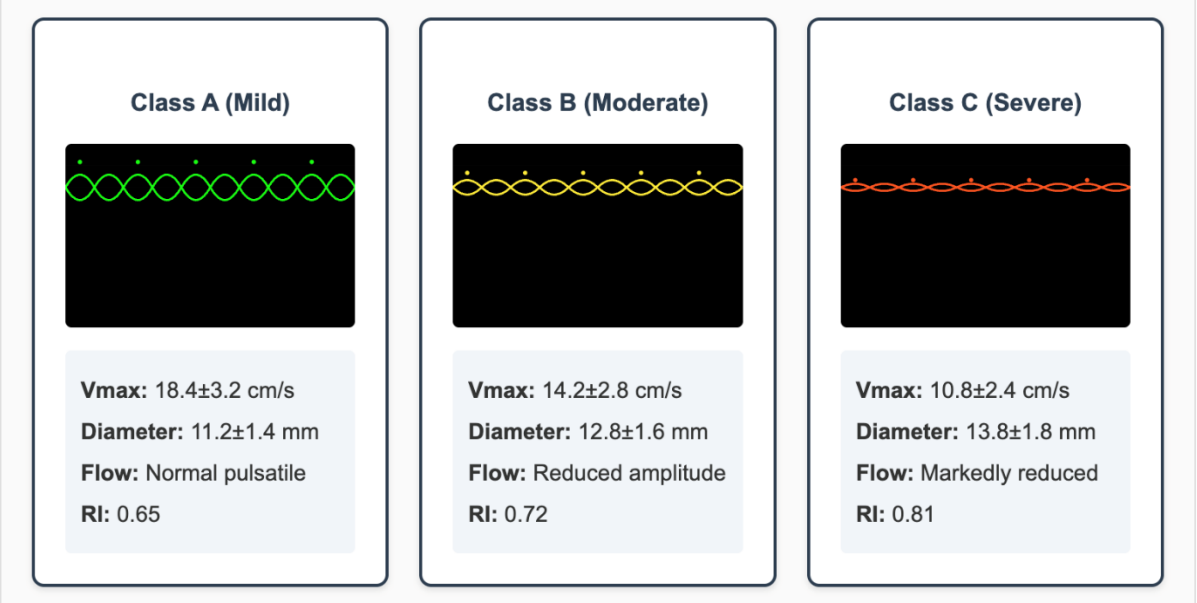

Fig. 1. Doppler pattern of portal blood flow at different severity of obstructive jaundice

Table 3. Types of surgical interventions in study groups

Type of intervention	Main group (n=296)	Control group (n=128)
Minimally invasive interventions		
EPST	48 (16.2%)	18 (14.1%)
EPST + lithoextraction	92 (31.1%)	24 (18.8%)
EPST + NBD	28 (9.5%)	12 (9.4%)
PTCS	48 (16.2%)	8 (6.3%)
Choledochal stenting	24 (8.1%)	6 (4.7%)
Traditional operations		
Choledocholithotomy	32 (10.8%)	48 (37.5%)
Choledochoduodenostomy	18 (6.1%)	22 (17.2%)
Choledochojejunostomy	14 (4.7%)	16 (12.5%)
Transduodenal papillosphincterotomy	8 (2.7%)	14 (10.9%)

Maximum systolic blood flow velocity indicators in the hepatic artery (TAMX) also correlated with obstructive jaundice severity. At bilirubin levels below 60 μmol/L, TAMX was 68.4±12.3 cm/s, at bilirubin 60-100 μmol/L - 58.2±10.8 cm/s, at bilirubin over 100 μmol/L - 51.3±9.6 cm/s ($p<0.01$). Thus, at bilirubin levels over 100 μmol/L, the TAMX indicator was 25% lower compared to mild jaundice.

Magnetic resonance cholangiopancreatography was performed in 186 patients of the main group (62.8%) and 42 patients of the control group (32.8%). MRCP allowed accurate determination of the bile duct obstruction level in 96.4% of cases, detection of choledochal stones in 88.2% of patients with choledocholithiasis, and diagnosis of bile duct strictures with determination of their extent and localization in 94.7% of observations.

Endoscopic retrograde cholangiopancreatography was performed in 218 (73.6%) patients of the main group and 86 (67.2%) patients of the control group. In the main group, ERCP was supplemented with therapeutic manipulations in 184 (84.4%) cases: EPST was performed in 168 patients, lithoextraction in 92, nasobiliary drainage in 48, choledochal stenting in 24 patients. In the control group, therapeutic endoscopic interventions were performed in 54 (62.8%) patients.

Percutaneous transhepatic cholangiostomy under ultrasound control was performed in 48 (16.2%) patients of the main group when endoscopic interventions were impossible. Indications for PTCS were: inability to cannulate the major duodenal papilla during ERCP (18 patients), extended strictures of proximal bile ducts (14 patients), Mirizzi syndrome (8 patients), altered anatomy after gastric resection (8 patients).

In the main group, staged treatment tactics using minimally invasive technologies were applied. Single-stage minimally invasive intervention was performed in 102 (34.5%) patients - these were patients with choledocholithiasis and small stones who underwent EPST with lithoextraction. Two-stage minimally invasive intervention was performed in 39 (13.2%) patients - the first stage involved biliary decompression (EPST with NBD or PTCS), the second stage after stabilization - final sanitation of bile ducts by endoscopic method. Two-stage combined treat-

ment (minimally invasive intervention + traditional operation) was performed in 60 (20.3%) patients.

In the control group, traditional open interventions were predominantly performed. Choledocholithotomy was performed in 48 (37.5%) patients, choledochoduodenostomy in 22 (17.2%), choledochojejunostomy in 16 (12.5%), transduodenal papillosphincterotomy in 14 (10.9%) patients.

Analysis of immediate treatment results showed that the application of differentiated tactics using minimally invasive technologies reduced the frequency of postoperative complications. In the main group, complications developed in 58 (19.5%) patients, in the control group - in 34 (26.6%) patients ($p<0.05$). Structure of complications in the main group: acute pancreatitis after EPST - 12 (4.1%), bleeding from papillotomy incision - 6 (2.0%), cholangitis - 14 (4.7%), bile leakage - 8 (2.7%), wound complications - 10 (3.4%), others - 8 (2.7%). In the control group, wound complications predominated - 12 (9.4%), bile leakage - 8 (6.3%), cholangitis - 6 (4.7%).

Mortality in the main group was 4.05% (12 patients), in the control group - 6.5% (8 patients). The main causes of fatal outcomes were: hepatorenal failure (8 cases), sepsis (6 cases), pulmonary embolism (3 cases), acute myocardial infarction (3 cases).

The average duration of hospitalization in the main group was 12.4±4.8 days, in the control group - 18.6±6.2 days ($p<0.001$). The reduction in hospitalization time in the main group was due to the use of minimally invasive technologies, less traumatic interventions, and reduced complication frequency.

Long-term results were traced in 186 (62.8%) patients of the main group and 74 (57.8%) patients of the control group within periods from 6 months to 3 years. Good results (absence of disease recurrence, satisfactory quality of life) were noted in 156 (83.9%) patients of the main group and 54 (73.0%) patients of the control group. Satisfactory results (presence of periodic pain, need for medication therapy) were observed in 24 (12.9%) and 14 (18.9%) patients respectively. Unsatisfactory results (disease recurrence, repeated operations) were noted in 6 (3.2%) patients of the main group and 6 (8.1%) patients of the control group.

The use of minimally invasive technologies in treating benign obstructive jaundice has several advantages over traditional methods. First, minimally invasive interventions allow bile duct decompression with minimal trauma, which is especially important in patients with severe jaundice and high operative risk. Second, staged treatment with preliminary biliary decompression promotes liver function recovery and endotoxemia reduction, creating more favorable conditions for radical interventions. Third, the use of endoscopic methods allows avoiding traditional operations in some cases, which is especially relevant for elderly and senile patients with severe comorbid pathology.

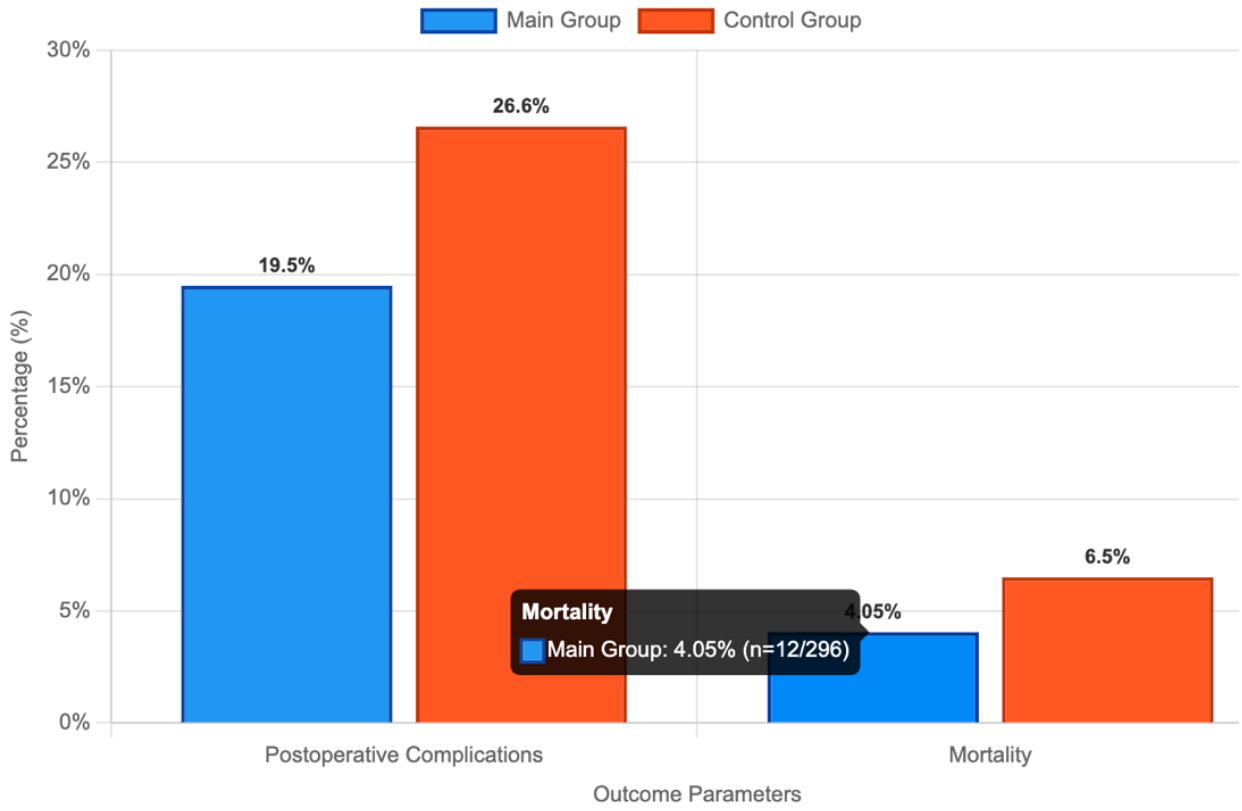

Fig. 2. Comparative characteristics of complications and mortality

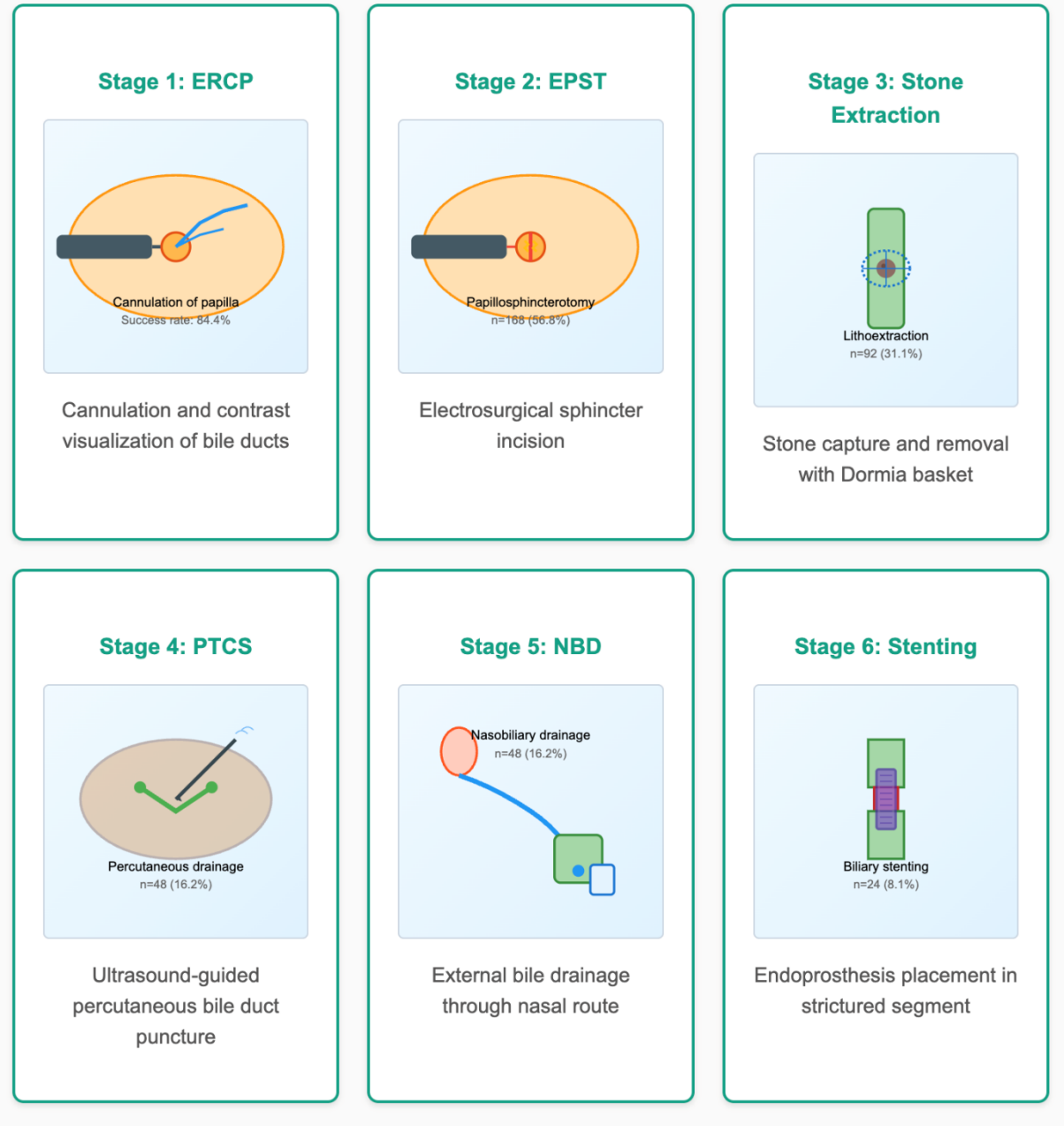

Fig. 3. Stages of minimally invasive interventions

At the same time, minimally invasive technologies have their limitations and cannot completely replace traditional surgical interventions. In cases of extended bile duct strictures, Mirizzi syndrome type II-III, and pronounced inflammatory changes in the hepatoduodenal ligament area, preference should be given to open operations. Additionally, failures and complications of minimally invasive interventions are also indications for traditional surgical treatment.

Doppler examination of hepatic hemodynamics is an important method for assessing the functional state of the liver in obstructive jaundice. The decrease in portal blood flow velocity and increase in portal vein diameter that we identified with increasing jaundice severity reflects the development of portal hypertension due to cholestatic liver damage. The decrease in arterial inflow through the hepatic artery indicates disruption of compensatory mechanisms of hepatic blood flow. These changes correlate with morphological changes in the liver - development of cholestatic hepatitis and periportal fibrosis, which is confirmed by liver biopsy data.

Our developed therapeutic and diagnostic algorithm is based on a comprehensive approach considering the etiology of obstructive jaundice, its severity, and liver functional state. The use of modern non-invasive diagnostic methods (ultrasound with Doppler, MRCP) at the first stage allows establishing the cause and level of biliary obstruction and assessing liver functional state in most cases. ERCP and PTC are used not only as diagnostic but also as therapeutic methods allowing biliary decompression.

The differentiated approach to choosing the biliary decompression method is based on the following principles. For choledocholithiasis with stones up to 10 mm in size, the method of choice is EPST with

lithoextraction. For large stones, EPST with lithotripsy or nasobiliary drainage followed by lithoextraction is indicated. For stenosis of the major duodenal papilla, EPST is performed, supplemented with balloon dilation if necessary. For benign strictures of distal choledochal sections, stenting is effective. When endoscopic interventions are impossible or in cases of proximal bile duct strictures, PTCS is indicated.

An important aspect is determining the optimal timing for radical interventions after preliminary biliary decompression. According to our data, for class B obstructive jaundice, optimal radical surgery should be performed 7-10 days after decompression when bilirubin levels decrease to 60-80 μmol/L. Class C obstructive jaundice requires longer preparation - 14-21 days, until bilirubin decreases below 100 μmol/L and liver protein-synthetic function recovers.

Analysis of failures and complications of minimally invasive interventions showed that the main causes of EPST ineffectiveness were: impacted stone in the major papilla (8 cases), parapapillary diverticulum (6 cases), extended stricture of the terminal choledochus (4 cases). EPST complications (acute pancreatitis, bleeding) in most cases were associated with technical errors in performing the intervention. Complication prevention includes strict adherence to EPST technique, adequate selection of papillotomy incision size, and use of pancreatic stenting in high-risk pancreatitis cases.

The use of percutaneous transhepatic interventions under ultrasound control is an effective method of biliary decompression when endoscopic interventions are impossible. The use of modern ultrasound devices with high resolution allows targeted puncture of dilated bile ducts and minimizes the risk of complications. The main complications of PTCS are: hemobilia (4 cases), bile leakage into the abdominal cavity (2 cases), cholangitis (3 cases). Complication prevention includes proper selection of the puncture point, use of adequate diameter drains, and antibiotic therapy.

Comparative analysis of treatment results showed the advantages of a differentiated approach using minimally invasive technologies. The reduction in postoperative complications in the main group was due to less traumatic interventions, a staged approach to treatment with preliminary biliary decompression and patient stabilization. The decrease in mortality was associated with more careful patient selection for various types of interventions and the use of minimally invasive methods in patients with high operative risk.

Economic analysis showed that despite the higher cost of minimally invasive technologies, the total treatment costs for patients in the main group were lower due to reduced hospitalization time, decreased medication consumption, and reduced frequency of complications requiring additional treatment.

Thus, the use of minimally invasive technologies in the comprehensive treatment of benign obstructive jaundice is a pathogenetically justified and clinically effective approach that improves treatment results for this category of patients. Further development and improvement of minimally invasive methods and the development of new technologies for biliary decompression and bile duct reconstruction represent a promising direction in biliary surgery.

Conclusions:

1. Diagnosis of BOJ should be comprehensive using the developed diagnostic algorithm, including modern non-invasive radiological methods (ultrasound, MRCP) of diagnosis, as well as invasive puncture and endoscopic methods (ERCP, PTC) with transition to bile duct decompression, which was performed in 73.64% of patients in the main group.

2. Doppler studies of liver hemodynamics revealed a significant decrease in maximum blood flow velocity in the portal vein by 1.3 and 1.7 times in class B and C obstructive jaundice respectively with an increase in vessel diameter. Maximum blood flow velocity TAMX indicators with bilirubin levels over 100 mmol/L were 25% lower.

3. The presence of class B and C BOJ is an indication for using minimally invasive intervention as the initial stage (EPST with NBD or PTCS); when EPST is impossible (16.21%), the method of choice for the first stage of treatment is antegrade echo-controlled interventions - PTCS under ultrasound control. Radical surgical correction is indicated after patient stabilization at level A or B.

4. The choice of method and technique of minimally invasive decompressive intervention in each specific case has a strictly differentiated approach and is possible as single-stage minimally invasive intervention (34.45%), two-stage minimally invasive intervention (13.20%), or two-stage combined minimally invasive and traditional intervention (20.27%). In cases of unsuccessful application or complications during minimally invasive interventions, as well as in development of postoperative obstructive jaundice and extended bile duct strictures, open laparotomy interventions are the optimal treatment methods.

5. The application of differentiated surgical tactics using pathogenetically justified methods of minimally invasive decompressive interventions on bile ducts and open reconstructive-restorative interventions contributed to a reduction in postoperative complications from 26.6% to 19.5% and fatal outcomes from 6.5% to 4.05% in the main group compared to control group patients.

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КЛИНИЧЕСКОЕ ОБОСНОВАНИЕ МАЛОИНВАЗИВНЫХ ТЕХНОЛОГИЙ ДРЕНИРОВАНИЯ ЖЕЛЧНЫХ ПРОТОКОВ ПРИ МЕХАНИЧЕСКОЙ ЖЕЛТУХЕ

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Резюме. *Доброкачественная механическая желтуха представляет собой серьезную медицинскую проблему, требующую комплексного подхода к диагностике и лечению. В настоящем исследовании проанализированы результаты лечения 424 больных доброкачественной механической желтухой за период с 2015 по 2024 год. Основную группу составили 296 пациентов, которым проводился дифференцированный подход с использованием этапных методов лечения с приоритетным применением малоинвазивных технологий. Группу сравнения составили 128 пациентов, которым проводилось традиционное лечение. В ходе исследования показано, что применение комплексного диагностического алгоритма, включающего современные неинвазивные лучевые методы диагностики в сочетании с инвазивными пункционными и эндоскопическими методиками, позволило выполнить декомпрессию желчных протоков у 73,64% пациентов основной группы. При допплерометрическом исследовании выявлено достоверное снижение скорости кровотока в воротной вене при механической желтухе класса B и C. Применение дифференцированной хирургической тактики с использованием патогенетически обоснованных малоинвазивных декомпрессивных вмешательств способствовало снижению послеоперационных осложнений с 26,6% до 19,5% и летальности с 6,5% до 4,05%. Результаты исследования демонстрируют эффективность малоинвазивных технологий в комплексном лечении больных с доброкачественной механической желтухой.*

Ключевые слова: *Механическая желтуха, малоинвазивные технологии, дренирование желчных протоков, эндоскопическая папиллосфинктеротомия, чрескожная чреспеченочная холангиостомия.*