

# SURGICAL APPROACH FOR TREATMENT OF OBSTRUCTIVE JAUNDICE IN PATIENTS OF DIFFERENT AGE GROUPS

DOI: 10.36740/WLek202302114

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## ABSTRACT

**The aim:** Assessment of the effectiveness of using minimally invasive and open methods of bile duct decompression for treatment of obstructive jaundice (OJ) by comparing complications in patients of different age groups.

**Materials and methods:** We analyzed the results of surgical treatment of 250 patients with OJ. The patients were assigned to two groups: Group I (n = 100) consisting of young and middle-age patients, and Group II (n = 150) consisting of elderly, senile and long-living patients. The average age was  $52 \pm 6.0$  years.

**Results:** 62 (24.8%) Group I patients and 74 (29.6%) Group II patients were submitted to minimally invasive surgical interventions. 38 (15.2%) Group I patients and 76 (30.4%) Group II patients were submitted to open surgical interventions. Complications after minimally invasive surgery (n = 62) in Group I patients were observed in 2 (3.2%) cases, and in 4 (10.5%) cases after open surgeries (n = 38). Complications following minimally invasive interventions (n = 74) in Group II patients were registered in 5 (6.8%) cases, and in 9 (11.8%) cases following open operations (n = 76). 2 (2.6%) Group II patients died for transmural myocardial infarction.

**Conclusions:** The use of minimally invasive surgical interventions for treatment of young and middle-aged OJ patients compared to patients of older age groups makes it possible to reduce the frequency of complications by 2.1 times, which is a statistically significant ( $p < 0.05$ ). The frequency of complications after open surgical interventions of bile ducts in patients of different age groups is not statistically significant ( $p > 0.05$ ).

**KEY WORDS:** endoscopic transpapillary interventions, laparoscopic lithoextraction, biliodigestive anastomoses, external drainage of biliary ducts

Wiad Lek. 2023;76(2):339-345

## INTRODUCTION

OJ patients account for one of the most challenging categories of patients with abdominal pathologies with a share in the emergency surgery of 2.6-23.7% [1, 2]. Along with significant advancement in treatment of OJ patients, biliary decompression is often accompanied by development of post-operative liver failure [3, 4]. This complication is called post-decompression liver dysfunction ("rapid biliary decompression syndrome"), which is difficult to treat and lethal in 14-27% of cases [5, 6]. Today, minimally invasive interventions are used along with open methods of bile ducts decompression. Using minimally invasive techniques for treatment of OJ patients has become one of the leading trends in surgery [7, 8]. Biliary surgery today sustains the trend of multi-stage minimally invasive interventions considering the severity of OJ patients' condition [9, 10]. Yet, gaining an experience, surgeons have been increasingly using the one-stage treatment approach [11, 12]. However, the pivotal question of biliary surgery remains a choice of bile ducts decompression technique for patients of different age groups, with different duration

of OJ and bilirubin count, burdened with complications and concomitant pathologies [13, 14].

## THE AIM

Assessment of the effectiveness of using minimally invasive and open methods of bile duct decompression for treatment of OJ by comparing complications in patients of different age groups.

## MATERIALS AND METHODS

In the period from 2002 to 2020, 250 patients, including 146 (58.4%) female and 104 (41.6%) male subjects with OJ of benign and malignant origin underwent treatment at the surgical clinic of the Medical Faculty No.2 of the National Pirogov Memorial Medical University, Vinnytsia. The patients were assigned to age groups according to WHO recommendations. Young, middle-age, elderly, senile, and long-living individuals accounted to 32 (12.8%), 68 (27.2%), 88 (35.2%), 56 (22.4%) and 6 (2.4%) patients, accordingly. The average age was  $52 \pm$

6.0 years. 98 (39.2%) had OJ duration up to 7 days, 62 (24.8%) - 7-14 days, 30 (12.0%) - 14-21 days, 35 (14.0%) - 21-28 days, and 25 (10.0%) – over 28 days. The average duration of OJ was  $19 \pm 3.5$  days.

Benign OJ observed in 210 (84.0%) patients accounted for choledocholithiasis - 149 (59.6%), Myrizzi's syndrome - 16 (6.4%), stricture of common bile duct (CBD) - 8 (3.2%), stenotic papillitis - 19 (7.6%), chronic fibrous pancreatitis - 10 (4.0%), cyst of the pancreatic head - 5 (2.0%), duodenal ulcer (DU) with penetration into the hepatoduodenal ligament (HDL) - 3 (1.2%) cases. Malignant OJ genesis in 40 (16.0%) patients accounted for the pancreas head cancer - 23 (9.2%), tumor of the major duodenal papilla (MDP) - 5 (2.0%), bile ducts cancer - 8 (3.2%), HDL-involving gallbladder cancer - 2 (0.8%), and other malignancies spreading in porta hepatic - 2 (0.8%).

Study patients were divided into two groups: Group I (young and middle-age patients) consisting of 100 individuals, and Group II (elderly, senile, and long-living patients) inclusive of 150 persons.

The research was conducted in compliance with the major principles of GCP guidelines (1996), Council of Europe Convention on Human Rights and Biomedicine (1997), World Medical Association Declaration of Helsinki on ethical principles for medical research involving human subjects (1964-2000) and Order of Ministry of Health of Ukraine № 281 of November 1, 2000, being approved by the Committee on Bioethics of the National Pirogov Memorial Medical University, Vinnytsia (Minutes No. 30 dated 10.12.2018).

General clinical, laboratory, and instrumental study methods were used for diagnostics. Instrumental research methods included: transabdominal ultrasonography (TUS), endoscopic ultrasonography (EUS), fibrogastroduodenoscopy (FGDS), endoscopic retrograde cholangiopancreatography (ERCP), intraoperative cholangiography (IOC), magnetic resonance imaging (MRI). TUS involving Lodgiq-500 PRO Series GE apparatus was used for screening of gallbladder and bile ducts pathologies in all patients. Pentax-290V fibrogastroduodenoscope was used for FGDS, of OJ patients. 10-20 ml of 30% water-soluble dye was administered for direct contrast of bile ducts in ERCP. IOC was performed by administering 10-20 ml of 30% contrast matter through the bile ducts. If it was impossible to cannulate the MDP, we resorted to EUS using Olympus Exera EU M 60 apparatus. In case of pancreatic diseases, we performed MRI using a Somatom-CR scanner.

The obtained data were statistically processed using descriptive statistic methods involving Microsoft Office Excel 2010 spreadsheet. As quantitative indicators, we calculated sample mean, standard deviation, and mean

error. The study was based on the hypothesis of checking statistical significance of the difference between average indicators of complications in Group I and II patients. The pre-estimated normal distribution of the sample data made it possible to use the Student's t-test for their comparison and the assessment of significance at the appropriate threshold of confidence probability  $P=0.95$  (a statistically significant difference is considered statistically reliable at a significance level of at least 0.05 ( $p < 0.05$ )).

## RESULTS

The informativity of TUS in diagnosing the causes of OJ made 160 (64.0%). TUS helped to diagnose bile ducts dilatation and the presence of calculi. EUS was used in case of unsatisfactory TUS results and impossibility of MDP cannulation. The reasons for unsatisfactory TUS results were severe flatulence - 8 (3.2%), obesity - 6 (2.4%), the presence of multiple small calculi in the terminal CBD department - 5 (2.0%), and aerocolia - 3 (1.2%). EUS was also useful for objective assessment of the CBD terminal department and calculi diameter ratio.

All OJ patients were subjected to FGDS, which contributed to assessment of MDP shape and size, and the nature of secreted bile. FGDS diagnosed MDP cancer and HDL-penetrating DU in 5 (2.0%) and 3 (1.2%) patients, accordingly. FGDS was also used to perform a differential diagnostics of OJ between a calculi wedged in the distal CBD and a pathology of the MDP.

ERCP was performed in 85 (34.0%) cases. Choledocholithiasis and stenotic papillitis were diagnosed in 66 (26.4%) and 19 (7.6%) patients, respectively. ERCP failed in 32 (12.8%) cases due to the presence of a concrement in the MDP ampoule, parapapillary diverticulum, and after the Billroth II stomach resection in 20 (8.0%), 10 (4.0%) and 2 (0.8%) cases, accordingly. Post-ERCP complications occurred in 11 (4.4%) patients, including acute pancreatitis in 6 (2.4%), acute cholangitis in 3 (1.2%) and haemorrhage from the MDP in 2 (0.8%) if ERCP was combined with endoscopic papillosphincterotomy (EPST).

60 (24.0%) patients were subjected to IOC. Following open cholecystectomy (OCE), water-soluble contrast matter was administered into bile ducts through the cystic duct stump in 28 (11.2%) and by CBD puncture in 18 (7.2%) cases. During laparoscopic cholecystectomy (LCE), 14 (5.6%) patients were subjected to IOC through the cystic duct. Choledocholithiasis, Myrizzi's syndrome, CBD stricture, bile ducts cancer, and gallbladder cancer with penetration into HDL were diagnosed in 26 (10.4%), 16 (6.4%), 8 (3.2%), 8 (3.2%), and 2 (0.8%), accordingly. Post-IOC complications were observed in 7

(2.8%) patients, including acute pancreatitis and acute cholangitis in 4 (1.6%) and 3 (1.2%) cases, respectively.

MRI was used for diagnosing pancreas pathologies in 38 (15.2%) patients, including pancreatic head cancer, chronic fibrous pancreatitis, and pancreatic head cyst in 23 (9.2%), 10 (4.0%), 5 (2.0%) cases, accordingly.

OJ patients were subjected to surgical interventions on the top of complex conservative therapy aimed at preventing the development of hepatic insufficiency, which comprised of infusion therapy, hepatoprotectors, glucocorticosteroids, antisecretory therapy, antispasmodics, antibiotics, vitamins, blood-improving therapy, acid-base, protein, and electrolyte balance enhancers. The patients received pre- and post-surgery comprehensive conservative therapy.

136 (54.4%) patients in both groups were submitted to minimally invasive surgical interventions, and 114 (45.6%) – to open surgeries.

62 (24.8%) Group I patients were submitted to minimally invasive surgical interventions. One-stage minimally invasive interventions were used in 24 (9.6%) cases. LCE with lithoextraction involving Fogarty balloon-tipped catheter was used in 15 (6.0%) patients having calculi up to 5 mm positioned below the confluence of the cystic duct into the common hepatic duct. LCE with external CBD drainage was performed in 9 (3.6%) patients with Mirizzi's syndrome type I.

Two-stage minimally invasive interventions were used in 38 (15.2%) patients. At the first stage, endoscopic papillary balloon dilation was performed in 4 (1.6%) patients with single calculi up to 5 mm in size localized in the distal CBD departments, using 4- and 6 mm cylinders pressurized within the range of 4-9 atm. The dilation continued 15-60 seconds. At the first stage, 23 (9.2%) patients with choledocholithiasis were submitted to incomplete EPST (up to 10 mm), which made possible independent discharge of calculi up to 10 mm in diameter. Incomplete EPST was also used in 11 (4.4%) patients with stenotic papillitis. At the second stage, LCE was performed after the elimination of OJ. The second stage was performed on Day 3-10 depending on the severity of patients' condition.

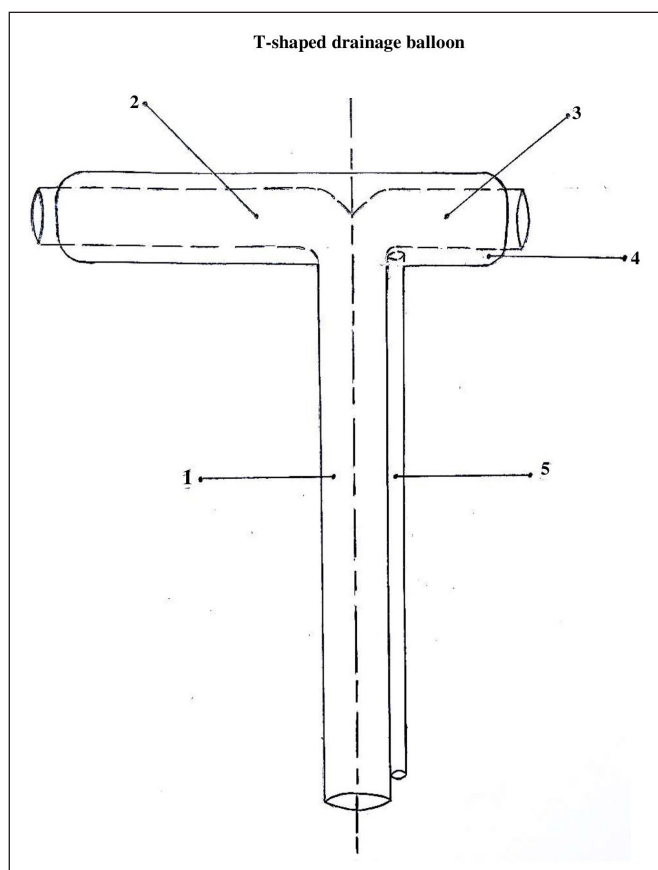
74 (29.6%) Group II patients were submitted to minimally invasive surgical interventions. One-stage minimally invasive interventions were used in 14 (5.6%) cases. Endobiliary transpapillary stenting (7 Fr stent) was used for long-term decompression of bile ducts in 4 (1.6%), 5 (2.0%), and 5 (2.0%) patients with terminal CBD stricture, MDP cancer, and pancreas head cancer, accordingly. The stent was replaced in 3-4 months once inlaid with bile acid salts.

Two-stage minimally invasive interventions were used in 60 (24.0%) patients. Complete EPST (over 10

mm) was performed in 20 (8.0%) patients with choledocholithiasis, which made it possible to perform lithoextraction with a Dormia basket (Olympus FG-22Q, Boston scientific trapezoid RX). Complete EPST was also followed by mechanical lithotripsy involving Olympus BML-201Q lithotripter in 12 (4.8%) patients with 10-20 mm concrements. The fragmented concrements were removed then with a Dormia basket. Complete EPST was also used in 8 (3.2%) patients with stenotic papillitis. Repeated gradual EPSTs were performed as rapid biliary decompression led to a progression of liver failure. 20 (8.0%) patients with signs of purulent cholangitis underwent EPST with a nasobiliary drainage. The presence of drainage made it possible to rehabilitate the bile ducts with antiseptic and antibiotic solutions. At the second stage, LCE was performed after the elimination of OJ. The second stage was performed on Day 5-14 depending on the severity of patients' condition.

38 (15.2%) Group I patients were submitted to open surgical interventions. 8 (3.2%) patients with concrements larger than 20 mm that was impossible to remove transpapillary underwent OCE with choledocholithotomy. In case of obstruction of distal CBD departments, a choledochoduodenoanastomosis was formed using intraoperative technique for prevention of duodenal contents reflux (Ukraine patent No.85986). A 15 mm-long longitudinal choledochotomy and duodenotomy of the crescent-shape in a transverse direction were performed. A "side-to-side" choledochoduodenoanastomosis was formed with a single-row nodal suture. A serous-muscular layer of the duodenum wall was captured by the suture during formation of the anastomosis upper edge. Once the suture is tightened, the crescent flap invaginated into the duodenal cavity, forming a slit-like valve. Post-surgery, the valve prevented rapid decompression of the bile ducts and duodenobiliary reflux. 15 (6.0%) patients with choledocholithiasis underwent areflux choledochoduodenostomy.

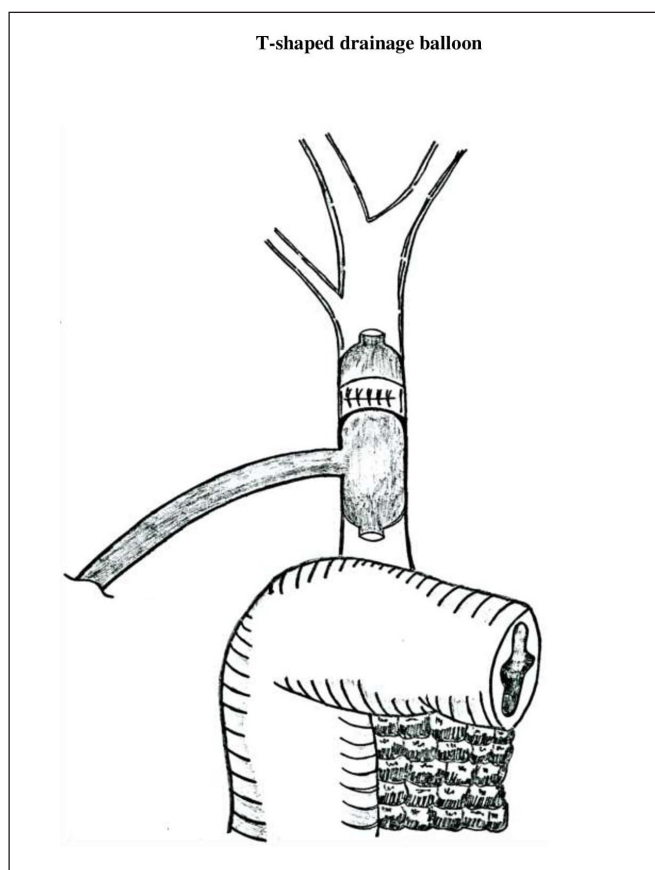
Combined areflux hepaticojejunoduodenostomy (Ukraine patent No.112735) was used in 11 (4.4%) patients with CBD stricture and Mirizzi's syndrome type II in 4 (1.6%) and 7 (2.8%) cases, accordingly. The areflux hepaticojejunostomy was formed "side-to-side". To do this, surgeons sutured and pulled up the anterior wall of the jejunum, thus forming a cone. Sub-ligature, the intestinal wall was excised and expanded the point opening with forceps in the transverse direction. A longitudinal hepaticotomy was performed and the anastomosis between the common hepatic duct and the jejunum with a single-row nodal suture was formed. Once a peristaltic wave passed, the intestinal wall "closed", thus preventing reflux of intestinal contents into the bile ducts and rapid biliary decompression in



**Fig. 1.** T-shaped drainage balloon  
longitudinal draining tube – 1; long transverse draining tube – 2; short transverse drainage tube – 3; balloon – 4; additional tube – 5

the postoperative period. The intestinal tube continuity was restored by applying an “end-to-side” interstitial anastomosis at a distance of 30-40 cm from the previously formed biliodigestive anastomosis. To prevent the formation of peptic ulcers and duodenostasis, an additional duodenojejunostomy was formed “side-to-side” between the excluded jejunum segment and the descending duodenum branch. In patients with pancreatic head cancer underwent pancreatoduodenal resection in 4 (1.6%) cases.

76 (30.4%) Group II patients were submitted to open surgical interventions. 18 (7.2%) patients with choledocholithiasis that was impossible concretions to remove transpapillary underwent OCE with choledocholithotomy. To prevent a post-decompression liver dysfunction a probe-obturator for extrahepatic bile ducts was used (Ukraine patent No.104826). Post-OCE, the probe-obturator was introduced into the CBD through the cystic duct stump. The balloons volume increased by injecting saline. In the postoperative period, the balloon-fixator prevented removal of the probe from the cystic duct stump. The balloon-obturator volume was gradually reduced for 7-10 days, which made it possible to perform dosed decompression of the bile ducts.



**Fig. 2.** T-shaped drainage balloon

29 (11.6%) patients with non-tumor OJ genesis underwent areflux choledochoduodenostomy, including choledocholithiasis, chronic fibrous pancreatitis, and pancreatic head cyst in 14 (5.6%), 10 (4.0%), and 5 (2.0%) cases, accordingly. Jurash supraduodenal choledochoduodenoanastomosis was used in 5 (2.0%) patients with pancreatic head cancer. A 15-20 mm anastomosis ensured a longer decompression of bile ducts in case of ascending type of tumor growth. Roux hepaticojejunostomy on the excluded loop of the small intestine was performed in 15 (6.0%) patients with malignant OJ genesis, including 8 (3.2%), 5 (2.0%), and 2 (0.8%) cases of bile ducts cancer, pancreatic head cancer, and gallbladder cancer with penetration into HDL, accordingly. A 15-20 mm hepaticojejunostomy ensured longer decompression of bile ducts in case of subsequent tumor growth. Also, patients with pancreatic head cancer underwent antegrade CBD stenting in 4 (1.6%). 2 (0.8%) patients were subjected to bouginage and stenting of hepaticocholedochus for cancer metastases originating from another location in the liver.

3 (1.2%) patients with DU that penetrated HDL underwent ulcer excision and duodenoplasty. After the separation, a 1/3 duct circle-long defect was formed in the CBD. To prevent forming stricture, a T-shaped drainage balloon was used (Ukraine patent No.104469).



**Table I.** Complications after minimally invasive surgical interventions

Complications	Group I (n=62)	Group II (n=74)	p
Clipping of the common hepatic duct	1	-	
Failure of cystic duct stump	1	-	
Pancreatic necrosis	-	1	
MDP bleeding	-	2	
Stent obstruction	-	2	
Total	2	5	
%	3,2%	6,8%	p<0.05

**Table II.** Complications after open surgical interventions

Complications	Group I (n=38)	Group II (n=76)	p
Failure of CBD sutures	1	2	
Failure of cystic duct stump	2	-	
Failure of biliodigestive anastomosis	-	3	
CBD damage	-	1	
External biliary fistula	-	2	
Cholemic bleeding	1	1	
Total	4	9	
%	10.5%	11.8%	p>0.05

T-shaped drainage balloon is a tool made in the form of elastic longitudinal draining tube 1, having a diameter of 5-mm, which is perpendicularly connected to a 2-cm long transverse draining tube 2 and a 1-cm short transverse drainage tube 3, both having a diameter of 4-mm, with a V-shaped recess at the junction of the upper walls of the transverse short and longer draining tubes. The distal end of the tool is equipped with a balloon 4 connected to an additional tube 5, having a diameter of 1-mm (Fig. 1).

Once the CBD defect is sutured, a T-shaped drainage balloon is inserted in a transverse direction through a separate incision in its wall below the lesion, followed by expanding the balloon by saline injection. The balloon positioned at the level of bile duct plasty, thus preventing its narrowing for a long time (Fig. 2). The drainage was easy to remove after reducing the balloon volume due to a V-shaped recess at the junction of the upper walls of the transverse short and longer draining tubes. Balloon dilation was administered for 3 months. No signs of CBD stricture were observed two years post-surgery.

## DISCUSSION

Along with significant advancement in treatment of OJ patients, biliary decompression is often accompanied by development of post-operative liver failure ("rapid

biliary decompression syndrome") [3-6]. Today, both open and minimally invasive surgical interventions are used in biliary surgery [7, 8]. Minimally invasive interventions are performed both in one and several stages [10-12]. However, in these studies, the criteria for choosing a method of bile ducts decompression in patients of different age groups remain uncertain.

According to the results of the study, no post-decompression liver dysfunction was observed after one-stage minimally invasive surgical interventions. Because, one-stage minimally invasive surgical interventions were performed in patients with hyperbilirubinemia below 200  $\mu\text{mol/l}$ , OJ duration up to 14 days, compensated or subcompensated concomitant pathology, and no concomitant purulent cholangitis and biliary pancreatitis. Two-stage minimally invasive surgical interventions were used for treatment of patients with bilirubin count over 200  $\mu\text{mol/l}$ , OJ duration over 14 days, the presence of comorbidities in the stage of decompensation, complicated by OJ purulent cholangitis and biliary pancreatitis. No significant functional disbalance of the liver was observed following two-stage minimally invasive surgical interventions. Because, two-stage approach involved endoscopic transpapillary interventions at the first stage and LCE at the second stage. The interval between minimally invasive interventions was 3-14 days, which was optimal for the post-decompression period. Open surgical interventions on bile ducts were

used when it was impossible to cope OJ by minimally invasive methods. The formation of areflux biliodigestive anastomoses was associated with a moderate rate of bile duct decompression preconditioned by a valve mechanism. External biliary decompression was associated with a rapid decrease of pressure in bile ducts, which led to post-decompression liver dysfunction and required dosed decompression of the bile ducts with a probe-obturator during 7-10 days and complex conservative therapy.

After minimally invasive surgical interventions, the average duration of hospital stay of Group I and II patients was  $5.0 \pm 1.2$  days and  $9.5 \pm 1.3$  days, accordingly. After open operations, the average length of hospital stay of Group I and II patients was  $10.2 \pm 1.2$  days and  $12.3 \pm 1.5$  days, accordingly.

In the course of the study, an assessment was given of the effectiveness of using minimally invasive and open methods of bile duct decompression for treatment of OJ by comparing complications in patients of different age groups. Complications after minimally invasive surgery (n = 62) were registered in Group I patients in 2 (3.2%) cases: clipping of the common hepatic duct - 1 (1.6%), failure of cystic duct stump - 1 (1.6%). No fatalities were registered. Complications following minimally invasive surgery (n = 74) in Group II patients were diagnosed in 5 (6.8%) cases: pancreatic necrosis - 1 (1.3%), MDP bleeding - 2 (2.7%), and stent obstruction - 2 (2.7%). No lethal cases were registered (Table I).

Complications after open surgery (n = 38) in Group I patients were observed in 4 (10.5%) cases: failure of CBD sutures - 1 (2.6%), failure of cystic duct stump - 2

(5.2%), cholemic bleeding - 1 (2.6%). No fatal cases were registered. Complications following open surgery (n = 76) in Group II patients were diagnosed in 9 (11.8%) cases: CBD damage - 1 (1.3%), external biliary fistula - 2 (2.6%), failure of CBD sutures - 2 (2.6%), failure of biliodigestive anastomosis - 3 (3.9%), and cholemic bleeding - 1 (1.3%). 2 (2.6%) OJ patients died of transmural myocardial infarction (Table II).

Compared to Group II patients, complications in Group I patients were observed 2.1 and 1.1 times less often after minimally invasive and open procedures, accordingly. Thus, these results suggested that the frequency of complications after minimally invasive surgical interventions in Group I patients was statistically significantly lower than the one in Group II patients ( $p < 0.05$ ). It should be noted that no statistically significant difference was found between the frequency of complications after open operations in the patients of I and II study Groups ( $p > 0.05$ ).

## CONCLUSIONS

1. The use of minimally invasive surgical interventions for treatment of young and middle-aged OJ patients compared to patients of older age groups makes it possible to reduce the frequency of complications by 2.1 times, which is a statistically significant ( $p < 0.05$ ).
2. The frequency of complications after open surgical interventions of bile ducts in patients of different age groups is not statistically significant ( $p > 0.05$ ). Therefore, should be used open surgical interventions when it was impossible to eliminate OJ by minimally invasive methods in patients of different age groups.

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*The article is a part of complex scientific research work at Surgery Department of the Medical Faculty No.2 of the National Pirogov Memorial Medical University, Vinnytsia, "Evaluation of the effectiveness of minimally invasive techniques and the use of various energy sources in the treatment of diseases of the gastrointestinal tract", state registration number 0120U101673.*

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#### **Conflict of interest:**

*The Authors declare no conflict of interest.*

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**Received:** 14.04.2022

**Accepted:** 18.01.2023

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**A** - Work concept and design, **B** - Data collection and analysis, **C** - Responsibility for statistical analysis, **D** - Writing the article, **E** - Critical review, **F** - Final approval of the article

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