

Endoscopic light-guided choledochoduodenostomy in the treatment of the distal common bile duct obstruction

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ABSTRACT

Aim: Experimental justification for creation of bile offtake into the duodenum with minimally invasive methods in cases of obstruction of the distal part of common bile duct and failure of transpapillary interventions and studying the first results of such intervention application.

Materials and Methods: The anatomical relationships between the duodenum and the common bile duct in its distal parts starting from its retroduodenal part to the sphincter of Oddi were studied. The possibility of transillumination of the walls of the common bile duct and the duodenum by a light source introduced into the lumen of the common bile duct is determined.

Results: The length of a conventional straight line between the lumens is from 7.1 ± 0.2 mm at a distance of 50 mm from the sphincter of Oddi to 4.7 ± 0.1 mm at a distance of 30 mm from the sphincter of Oddi. In the distance up to 40 mm from the sphincter of Oddi, the common bile duct and the duodenum are in close proximity to each other without free spaces, that predispose for the connection formation between the lumens of the duodenum and the common bile duct. The technology of endoscopic light-guided choledochoduodenostomy is substantiated, developed and implemented.

Conclusions: Created method of endoscopic light-guided choledochoduodenostomy allows to perform a conjunction between the lumens of the duodenum and the common bile duct. This intervention can be used when endoscopic transpapillary drainage of the common bile duct is impossible and has advantages over open draining bile duct operations in patients with tumor distal common bile duct obstruction.

KEY WORDS: cholangitis, biliary obstruction, minimally invasive interventions

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INTRODUCTION

Obstruction of the distal common bile duct due to benign or malignant process in most cases requires primary drainage of the biliary tract [1,4]. Endoscopic retrograde cholangiopancreatography (ERCP) with stenting of the common bile duct (with or without papillosphincterotomy) is recognized as the "gold standard" of biliary tract drainage, and technical success is usually obtained in most cases [2,4]. However, according to the literature data, failed biliary cannulation or stenting of the choledochus are observed in up to 10% of cases when distal common bile duct is obstructed due to oncological processes and the rigidity of tumorous tissues in this area [3,6].

In cases of failed transpapillary cannulation and stenting, alternative access methods to biliary decompression are needed: percutaneous transpapillary external drainage, open or laparoscopic external and

internal drainage, endoscopic ultrasound (EUS) internal biliary drainage (most often in the form of EUS-guided choledochoduodenostomy) [4,5]. It should be noted that percutaneous transhepatic biliary drainage is traditionally attempted as an alternative drainage method, but adverse event rates are reportedly relatively high. These negative aspects are directly related to the peculiarities of performing this intervention, as well as that is an external drainage method, which leads to indigestion because of bile absence in the duodenum and reduced quality of life. In general, laparoscopic external drainage interventions have similar disadvantages [7,8]. Open surgical interventions for biliary obstruction, compared with minimally invasive, are associated with much greater surgical trauma, which in turn leads to greater postoperative pain, longer postoperative period, increased postoperative complications, morbidity and mortality [9,10]. The hybrid approaches

such as EUS-guided choledochoduodenostomy or laparoscopic-cholangioscopic cooperative technique require careful patient selection, appropriate special equipment, experienced operator supported by a well-trained team in a multidisciplinary setting and has its own complications, for example, in the form of bleeding [4,11].

Thus, despite the fact that many scientific and practical efforts are devoted to the topic of bile ducts drainage in the case of distal lesions of common bile duct, this problem remains relevant due to its difficulty, that confirmed by numerous publications.

AIM

Experimental justification for creation of bile offtake into the duodenum with minimally invasive methods in cases of malignant obstruction of the distal part of common bile duct and failure of transpapillary interventions and studying the first results of such intervention application.

MATERIALS AND METHODS

During the primary drainage of the biliary system among patients with obstruction of the common bile duct of tumor etiology, in 19.7% cases transpapillary drainage was unsuccessful due to the technical impossibility of cannulating the bile ducts or the impossibility of papillosphincterotomy and stent placement due to the rigidity of the tissues near the large duodenal papilla. All these patients underwent percutaneous transhepatic and open draining surgical interventions for bile duct decompression. The fails in performing transpapillary biliary drainage in case of obstruction of the distal common bile duct dictated the need to develop other minimally invasive ways of diverting bile to the duodenum.

To solve the issue of alternative ("extrapapillary") bile drainage from the common bile duct to the duodenum, the anatomical relationships between the duodenum and the common bile duct in its distal parts were studied on the sectional material, starting from its retroduodenal part to the sphincter of Oddi. During the morphological study, the distance between the lumens of the choledochus and the duodenum was measured at different levels from 0 to 50 mm from the sphincter of Oddi.

The possibility of passing light through the walls of the common bile duct and duodenum by a light source introduced into the lumen of the common bile duct is also determined. A new method of bile drainage in the case of obstruction of the distal part of the choledochus

has been developed. The first results of using this technique are compared with the results of treatment with transpapillary interventions and open interventions.

ETHICS

Ethical approval was obtained from the ethics committee of the State Organization «V.T. Zaytsev Institute of General and Emergency Surgery of the National Academy of Medical Sciences of Ukraine», Kharkiv, Ukraine, including the aim of the study and confirmation that all data collected, will be kept confidential and used for scientific research only. The Study complies with the Declaration of Helsinki.

STATISTICAL ANALYSIS

Data were presented using descriptive statistics in the form of frequencies and percentages. The average values were used with a standard deviation; for the comparison of non-parametric values an χ^2 criterion was used; according to this criterion, p was determined ($p < 0,05$ was considered statistically significant).

RESULTS

Microscopic measurement of tissues cross-sections in the area of adjacency of the common bile duct to the duodenal wall revealed that the distance between the lumens of the common bile duct and the duodenum is unequal at different levels (Fig. 1).

According to the data obtained, the gap between the duodenal wall and the common bile duct has no free spaces starting from $50,1 \pm 0,2$ mm from the sphincter of Oddi. Therefore, the distance between the lumens of the duodenum and the common bile duct was measured during microscopic investigation at the distance of 50 mm, 40 mm, 30 mm, 20 mm and 10 mm from the sphincter of Oddi and directly in the area of the sphincter.

The results of measurements between the lumens of the common bile duct and duodenum are presented in Table 1.

Almost throughout the entire study area, the space between the lumens of the duodenum and the common bile duct consists of duodenal mucosa, its submucosal and muscle layers, adipose tissue and directly the wall of the common bile duct.

The length of the conditional straight line between the lumens is from 7.1 ± 0.2 mm at a distance of 50 mm from the sphincter of Oddi to 4.7 ± 0.1 mm at a distance of 30 mm from the sphincter of Oddi. Then, closer to the sphincter of Oddi, the length of the conditional straight line between

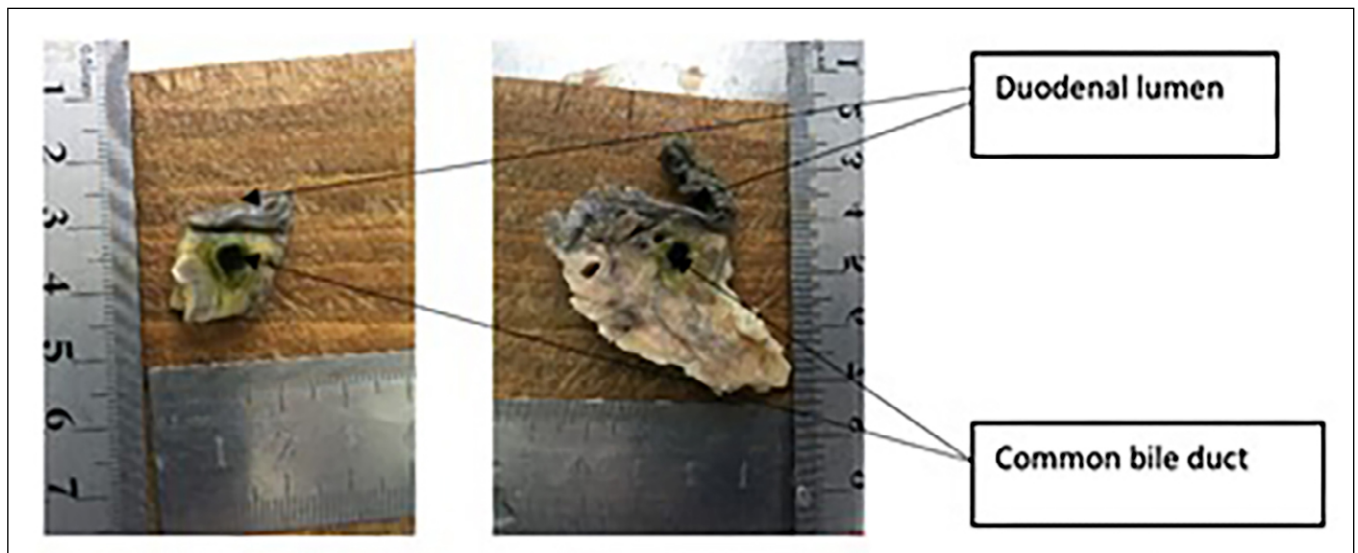


Fig. 1. Morphological sample of arrangement of the common bile duct and duodenum (cross section).

Table 1. Results of measurements between the lumens of the common bile duct and duodenum

Distance from Oddi's sphincter	The distance between the lumens of the common bile duct and the duodenum
50 mm	7,1±0,2 mm
40 mm	5,2±0,1 mm
30 mm	4,7±0,1 mm
20 mm	6,2±0,2 mm
10 mm	6,0±0,2 mm
0	3,5±0,1 mm

the duodenal lumen and lumen of the common bile duct increases to 6-6.5 mm at a distance of 10-20 mm from the sphincter of Oddi. The cause for increasing this distance is the artery, that occurs in about 85%, which follows the curvature of the common bile duct wall. (Fig. 2).

Further, even closer to the Oddi's sphincter, there is a significant shift of the common bile duct in the direction of the duodenal mucosa. The length of the straight line connecting the lumens of the duodenum and the common bile duct is reduced to 4-5 mm. Directly next to the sphincter of Oddi, the common bile duct is adjacent to the duodenal muscular layer, and the measured distance is 3.5 ± 0.1 mm.

Thus, in the area up to 40 mm from the sphincter of Oddi, the common bile duct and the duodenum are in close proximity to each other without voids, which is a prerequisite for the formation of a connection between the lumens of the duodenum and the common bile duct. A warning factor is the presence of an artery near the wall of the choledochus at a distance of 10-20 mm from the sphincter of Oddi.

Based on the above data, the possibility of establishing a connection between the lumens of the duodenum and the common bile duct due to the short distance

between these formations is substantiated. It should be noted that to prevent bleeding, you need to avoid damage to the artery in this area.

Visibility from the duodenal lumen of the light source introduced into the common bile duct was checked on the cadaver material. Through the opening in the hepaticocholedochus, a light source was passed on a conductor to the retroduodenal part of the common bile duct, and the translucency of this light source through the open wall of the duodenum was observed (Fig. 3).

It was revealed that the light source inserted the common bile duct is visualized from the lumen of the duodenum with different intensities up to 50 mm from the sphincter of Oddi (Fig. 4).

To perform a connection between the lumens of the duodenum and the common bile duct, the technology of endoscopic light-guided choledochoduodenostomy (ELCD) was created and implemented.

The insertion of a light source into the common bile duct to the site of its obstruction allows to identify the location of the obstruction, that visible from the adjacent part of the duodenum (i.e. to determine the point of the future junction). Also, it can be clarified the location of tissue dissection so that it does not fall into vessels and did not lead to bleeding. The light flux passes through optically inhomogeneous biological tissues, that allows to detect the presence of denser structures (bile stones, vessels).

PROCEDURE TECHNIQUE

A light source is inserted into the common bile duct through a dilated cystic duct laparoscopically to the point of its obstruction. Then endoscopically from the duodenum through its wall it is performed connection

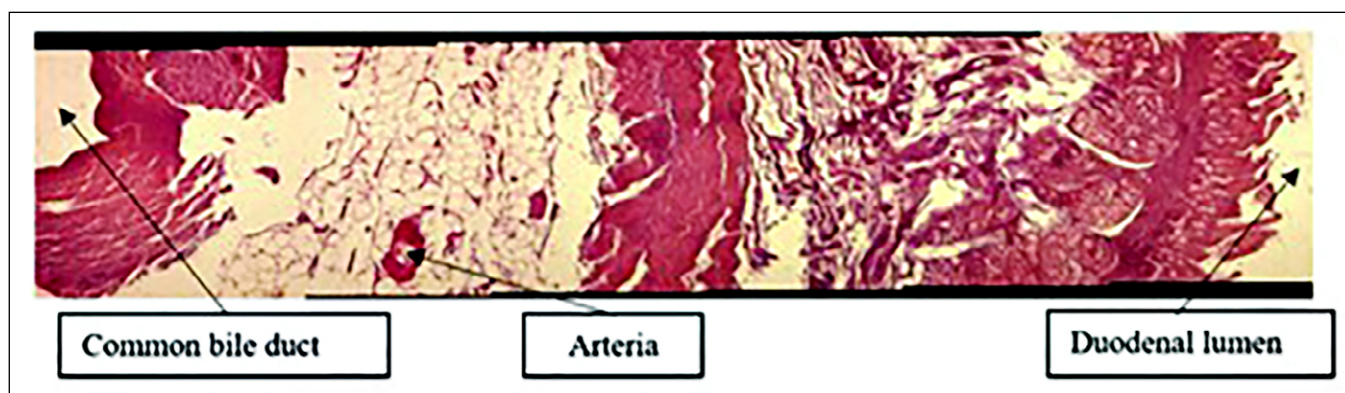


Fig. 2. Microscopy of the area between the lumens of the duodenum and the common bile duct (x60).

Table 2. Results of comparing after ELCD, ETD and BDA.

Parameter	ELCD (n=7)	ETD (n=10)	BDA (n=10)
Average indicator of PS *, points	3,6	2,2	7,5
Average duration of the postoperative period, days	6,7±0,5	5,3±0,3**	9,2±1,2
Complications,%	-	10%	20%
Beginning of enteral nutrition, days	1,5±0,3	0,9±0,1	2,8±0,5

* - PS (pain scale) 12 hours after surgery, points

** - the duration from the intervention to the patient's discharge or to the next stage of treatment.

Table 3. Dynamics of blood bilirubin decrease after ERLDC, EPDC and BDA, $\mu\text{mol/l}$

Type of intervention	Before intervention	After intervention		
		1st day	3d day	5th day
ELCD	170,2±13,4	113,8±12,5	67,1±6,7	20,6±4,9
ETD	181,5±9,8	105,7±10,3	59,3±7,5	17,5±3,4
BDA	203,6±15,8	130,7±11,5	79,5±9,1	35,9±5,2

between the lumens of the duodenum and the common bile duct with endoscopic knives or otherwise, focusing on light from the common bile duct (Fig. 5).

The criteria of the effectiveness of the intervention is the appearance of the contents of the common bile duct (bile, pus) in the duodenum lumen. Stenting of a new choledochoduodenal connection is not principally. The light source in the common bile duct to point of its obstruction can be delivered percutaneously transhepatic, percutaneously or laparoscopically through the gallbladder or cystic duct.

Thus, this procedure allows under visual (most informative) control to perform mini-invasive provision of bile outflow from the common bile duct to the duodenum in case of obstruction of choledoch's distal part and the impossibility of transpapillary interventions. The duration of the intervention was from 75 to 170 minutes.

According to this method it was performed 7 ELCD. The results after procedure in these patients were compared with the period after endoscopic transpapillary

drainage (ETD) and open biliodigestive anastomoses (BDA). The results of the comparison are presented in Table 2.

The changes in bilirubin concentration in the blood after ELCD, ETD and BDA are presented in Table 3.

DISCUSSION

Obstruction of the distal part of the common bile duct in the vast majority of cases is managed by endoscopic transpapillary interventions. However, in some cases drainage of the biliary tree using transpapillary interventions is unsuccessful for various reasons. This especially applies to patients with tumor lesions of the distal part of the common bile duct and large duodenal papilla. Alternative methods to biliary decompression (percutaneous external drainage, open or laparoscopic external and internal drainage and endoscopic ultrasound internal biliary drainage) have their own disadvantages [7]. Therefore, still it has been created new methods for draining bile to the duodenum when

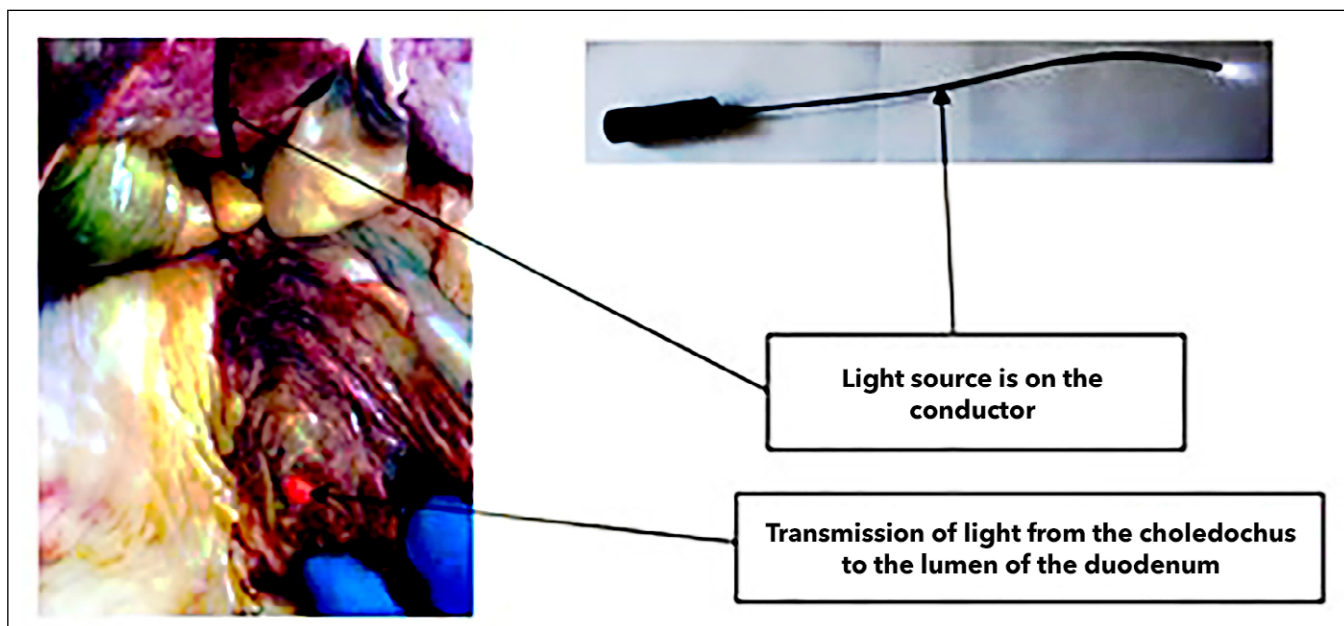


Fig. 3. A light source on a conductor introduced into the hepaticocolocholechos (morphological material).

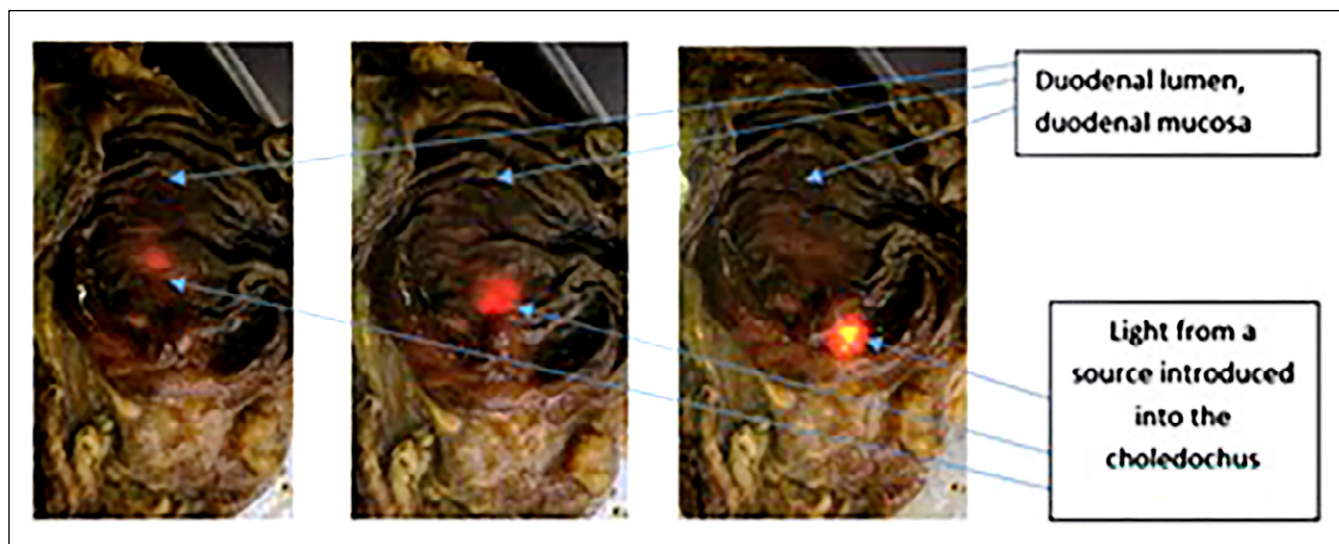


Fig. 4. Transillumination of light from the lumen of the common bile duct through the wall of the duodenum (morphological material).

transpapillary cannulation and stenting is failed. Based on the study of the anatomical relationship between duodenum and choledochus retroduodenal part, as well as on study of light transillumination through the walls of the common bile duct and duodenum, it was developed method of endoscopic light-guided choledochoduodenostomy (ELCD). This technique was performed in 7 patients, and we have analyzed fist results.

According to the comparison data, the results of ELCD are not statistically different from endoscopic transpapillary drainage of the common bile duct in dynamics of bilirubin decrease, pain assessment, duration of postoperative period and beginning of enteral nutrition. At the same time, there is statistically significant differences ELCD with open biliodigestive anastomoses for all studied parameters: significantly lower pain

rating scale ($p < 0.05$), shorter postoperative period ($p < 0.05$), less postoperative complications ($p < 0.05$), earlier possibility of the enteral nutrition ($p < 0.05$) and a more pronounced dynamic of bilirubin reducing in the blood ($p < 0.05$).

CONCLUSIONS

Thus, created method of endoscopic light-oriented choledochoduodenostomy allows to perform a conjunction between the lumens of the duodenum and the common bile duct. The results of this intervention are statistically better than the results of open biliodigestive anastomoses and comparable to endoscopic transpapillary drainage of the common bile duct. At present, this intervention can be used when endoscopic transpapillary

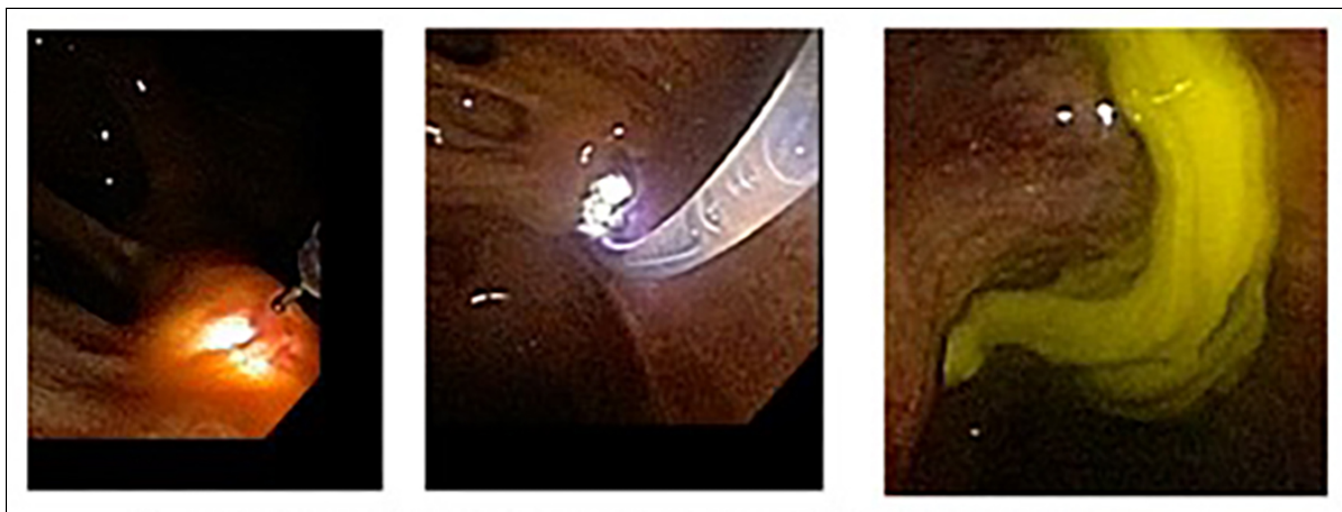


Fig. 5. Endoscopic light-guided choledochoduodenostomy.

drainage of the common bile duct is impossible and has advantages over open draining bile duct operations in patients with tumor distal common bile duct obstruction.

We would like to note that this article presents only the first results of implementing the Endoscopic

light-guided choledochoduodenostomy. We publish them to inform the public about the technique itself and about the first good results of its application. In the future, we will continue research and collect material so that the results will be more relevant.

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CONFLICT OF INTEREST

The Authors declare no conflict of interest

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