

Cholelithiasis and Laparoscopic Laser Lithotripsy. Single-Centre Experience: Randomized Controlled Trial

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Abstract

Objective: To evaluate the efficacy and safety of one-stage laparoscopic method of intraoperative choledochoscopy and contact laser lithotripsy in patients with cholelithiasis.

Summary Background Data: The laser technologies were used in these studies. According to our method, the indication for laparoscopic choledocholithotomy with a Holmium laser was the presence of a stone in common bile duct, regardless of its size. This combined method prevents serious complications in the early postoperative period and in the long term.

Methods: A method of contact laser lithotripsy with the use of a choledochoscope Olympus and Holmium Laser Dornier Medilas H 20 for performing targeted contact laser lithotripsy was described. Optimal and safe operating modes of the laser lithotripsy procedure were determined during these operations. An application of the proposed method allowed to perform simultaneously laparoscopic cholecystectomy and laser contact choledocholithotripsy without papillosphincterotomy and, in most cases, without the section of common bile duct (CBD).

Results: During our investigation we studied the laser effect on concretions in case of common bile duct stones. Adequate operative regulations of the laser were developed to crush the stones. All the concretions were fragmented. In this case, the effective energy varied within the limits of 0.5 - 1.0 Joules, with a pulse frequency of 5 - 10 Hz.

In the manner described above, 37 patients with cholecystocholedocholithiasis were operated on. There were no serious complications or lethal outcomes.

Conclusions: The use of this method allows to perform simultaneous laparoscopic cholecystectomy with laser contact choledocholithotripsy, preserving the anatomical integrity and physiological function of the sphincter of Oddi, conducting a complete visual control of the common bile duct during and after lithotripsy and performing surgery without the insertion of additional trocars.

Keywords: *Cholelithiasis; Choledocholithiasis; Contact Laser Lithotripsy; Holmium Laser*

Introduction

Despite the considerable success achieved in recent years in the surgery of biliary system, especially after the introduction of laparoscopic technology, the problem of choledocholithiasis treatment remains important. Choledocholithiasis, as a complication of cholelithiasis, occurs in 15 - 33% of patients [1,2], which in 58 - 85% of cases leads to mechanical jaundice, cholangitis (23 - 50%), acute pancreatitis (6 - 8%) [2,3].

Currently, most surgeons prefer a two-stage method for treating cholecystocholedocholithiasis. At the first stage, endoscopic papillosphincterotomy is performed with various types of lithotripsy and common bile duct stones extraction and, subsequently, the second stage is laparoscopic cholecystectomy. At the same time, the number of complications with two-stage operative interventions on biliary system is high and the percentage of unsatisfactory results, according to various factors, does not have a significant downward trend [3]. In addition, papillosphincterotomy is contraindicated for prolonged stenosis, including those caused by chronic pancreatitis, cysts of the head of pancreas; peripapillary diverticulum, specific anatomical features of the major duodenal papilla; large or multiple stones of common bile duct, with the impossibility of an adequate section of the sphincter and lithotripsy; duodenal stasis and severe coagulopathy [4].

Methods

In our work we used the laser device Dornier Medilas H 20 and the laparoscopic system "Olympus" (Japan). The Dornier Medilas H 20 is a holmium YAG laser especially designed for the treatment of stones and soft tissue, featuring 20 watts of power and 2.1 micron wave length, the impulse duration is 350 milliseconds. Complemented by a variety of flexible light guide fibers, virtually all stone locations are accessible in endoscopic applications.

The beginning of the operation fully corresponded to laparoscopic cholecystectomy. After the visualization of elements of the neck of gallbladder, we clipped and crossed the cystic artery. The distal part of the cystic duct was also clipped. Through the cystic duct, a choledochoscope "Olympus" CHF type P20 with a working IT diameter of 4,9 mm and a channel size of 2.2 mm, was inserted into the common bile duct. In the case of insufficient width of the cystic duct, it was mechanically dilated with a dissector. In case of the impossibility of choledochoscope insertion through the cystic duct, a choledochotomy was performed. After visualization of the stone in the common bile duct, the Holmium laser Dornier Medilas H 20 was brought to it and stage-by-stage fragmentation of the stone was performed. The procedure was continued till the formation of stone fragments 2 - 3 mm in size. Different laser power was used, it depends on the density of stone. Lithotripsy was performed in a pulsed mode with a frequency of 5 - 10 Hz and an energy of 0.5 - 1.0 Joules. After checking the permeability of the distal part of common bile duct, fragments of the stone were washed away into the duodenum. After the control checking of the bile ducts, a choledochoscope was removed from the common bile duct.

The main advantage of a Holmium laser is a good visualization of the working surface, it does not generate vapor bubbles (unlike other laser devices).

During the operation, vaporization occurs in the irrigation fluid near the tip of the optical fiber, where a vapor bubble appears with each laser flash. The diameter of the bubble depends on the energy of the laser flash; its width is several millimeters. The duration of the existence of a bubble is comparable to the duration of a laser flash, it is about 500 mcs. The human brain cannot perceive such short-term events, so the bubble is invisible.

When large fragments or multiple concretions were formed, the lithotripsy procedure was repeated until all the fragments migrated to the duodenum with the wash fluid stream. The lithotripsy process was performed under visual control in real time.

Thirty-seven patients underwent surgery during the study period. Common bile duct was drained through a stump of the cystic duct in 17 patients and through the common bile duct incision in 11 patients. The drainage tube was inserted through one of the trocar on the abdominal wall. In 9 patients common bile duct was not drained and the stump of the cystic duct was clipped. The gallbladder was extracted from the abdominal cavity through an incision above the umbilicus. The main indication of external drainage of common bile duct was the presentation of cholangitis and the duration of jaundice.

Results

During our investigation we studied the laser effect on concretions in case of common bile duct stones. Adequate operative regulations of the laser were developed to crush the stones. All the concretions were fragmented. In this case, the effective energy varied within the limits of 0.5 - 1.0 Joules, with a pulse frequency of 5 - 10 Hz.

In the manner described above, 37 patients with cholecystocholedocholithiasis were operated on. In all cases, mechanical jaundice was noted. In 18 patients, concretions were blocked and located in the terminal section of common bile duct. In 19 cases, the stones were freely located in the lumen of the common bile duct. In 12 cases there were destructive forms of cholecystitis. Purulent cholangitis was noted in 9 cases. Common bile duct was drained in all cases when signs of cholangitis were detected or a choledochotomy was performed.

According to our method, the indication for choledocholithotomy was the presence of a concretion in common bile duct, regardless of its size.

In two observations we used the traditional method of open choledocholithotomy. In one case, due to the severe stenosis of the distal part of the common bile duct we performed choledochoduodenostomy. In another observation the reason of laparotomy was the multiple large concretions in the common bile duct, which prevented the washing of the fragments into the duodenum. During the surgery it was found out that the distal stone was blocked into the ampulla of Vater.

In the early postoperative period, in two cases, bile flow occurred from the drainage, which independently ceased on the second and fourth days. Drainage tubes were removed after cholangiography.

There were no other serious complications or lethal outcomes.

The advantage of the proposed method is that common bile duct stones extraction is performed simultaneously with cholecystectomy without papillosphincterotomy and more often without choledochotomy, which prevents the jeopardy of serious complications in the early postoperative period and in the long term.

Conclusion

The use of this method allows perform simultaneous laparoscopic cholecystectomy with laser contact choledocholithotripsy, preserving the anatomical integrity and physiological function of the sphincter of Oddi, conducting a complete visual control of the common bile duct during and after lithotripsy and performing surgery without the insertion of additional trocars.

Compliance with Ethical Standards

Conflict of Interest

The authors declare that they have no competing interests.

Research involving human participants and/or animals

The present manuscript is in compliant with ethical standard. This study does not involve any kind of animal related contacts or experiments by any of the listed authors.

Informed Consent

All the patients included gave their informed consent.

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