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LETTER TO EDITOR

Treatment of incarcerated choledocholithiasis with holmium laser in laparoscopic bile duct exploration

KEYWORDS
Choledocholithiasis;
Holmium laser;
Laparoscope;
Treatment

To the editor,

Laparoscopic bile duct exploration (LCBDE) has been demonstrated as one of the safe and efficient options for the management of biliary calculi.[1,2] However, for incarceration of the ampulla or the large stones in the bile duct, especially hard sterol calculi, it is technically challenging to crush the stones directly with the lithotomy forceps, seriously affecting the ultimate therapeutic effect.[3,4]

This kind of promising technique, holmium laser, could be adopted to treatment of incarcerated choledocholithiasis. To our knowledge, this is report of treatment difficult-to-remove stones with holmium laser in LCBDE.

From January 2010 to January 2019, thirty-five patients had difficult-to-remove stones in the common bile duct were enrolled. The magnetic resonance cholangiopancreatography (MRCP) were performed to confirm stones in the common bile duct (Table 1). In briefly, during surgery, the hepatic duodenal ligament was dissected under laparoscopy, and the common bile duct was identified. Stone pliers were directly inserted into the common bile duct through the processus xiphoideus incision and the relatively large stones were clamped, then, the fiber choledochoscope was inserted into the common bile duct to examine the common and intrahepatic bile ducts and to understand the size and distribution of bile duct stones (Fig. 1). In the case of bile duct stone incarceration or a narrow lumen (Fig. 2), the fiber choledochoscope is used alternatively for stone removal with a known failure rate.

The holmium laser optical fiber was placed into the bile duct through the choledochoscope instrument incision. The energy and mode were adjusted according to the stone size and hardness during the procedure. After removing the stones, the T tube of 18–24 F was placed according to the expansion of the common bile duct. After 6 weeks, routine cholangiography was performed before withdrawing the T tube to ensure no residual stones.

All 35 patients successfully completed the operation without conversion to open surgery, and successfully treated with lithotripsy. The operative time was 80–150 min, with an average time of 106.0 ± 18.5 min. The holmium laser lithotripsy time was 8–25 min, with an average time of 15.1 ± 5.5 min. After lithotripsy, incarceration calculus removed rat was 100%. No procedure related complication or mortality was reported. Post-operative cholangiography showed that 2 patients had residual small stones in the lower segment of the common bile duct. After 2 months, repeat choledochoscopy, the residual stones were removed. All patients were followed for 6 months after extubation, and no residual stones were demonstrated in the biliary tract based on ultrasound examination.

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Table 1 Characteristics of MRCP.

Gender	Stones Characteristics				
	Combined with gallbladder stones	Single Stone	Multiple Stones	Diameter 1.0—2.0 cm	Diameter 2.0—3.0 cm
Female	7	12	7	5	14
Male	5	9	7	7	9

The holmium laser is associated with rapid and reliable lithotripsy, and results in no, if any, damage during regular surgical procedures. The holmium laser has the advantage of precise lithotripsy under direct vision of the choledochoscope.[5,6] Therefore, for the treatment of difficult-to-remove stones in the common bile duct, a holmium laser in conjunction with choledochoscopy can compensate for the shortcoming of simple choledochoscopy to crush large or incarcerated stones, and the choledochoscopy stone extractor can ultimately reach the stones. Thus, holmium laser lithotripsy is undoubtedly an effective treatment strategy.

In the process of holmium laser lithotripsy, it is believed that more attention should be paid to the following: 1) During LCBDE, the traits and hardness of the stone should be noted to determine the appropriate holmium laser output power, pulse volume, and pulse rate, and adjust the parameters according to the intra-operative situation. 2) The fiber head should be placed against the center of the stone during the procedure, and direct contact with the bile duct wall should be avoided during laser emission. Bile duct has inflammation should be noted and irrigation with water should be continuously performed to avoid bile duct damage. 3) To avoid damage to the choledochoscope, the laser fiber tip should be placed 1.5 cm above the choledochoscope. 4) An intermittent pulse should be used. When the stone is crushed or disengaged, the operation should be stopped to prevent tissue injury. 5) Continue to

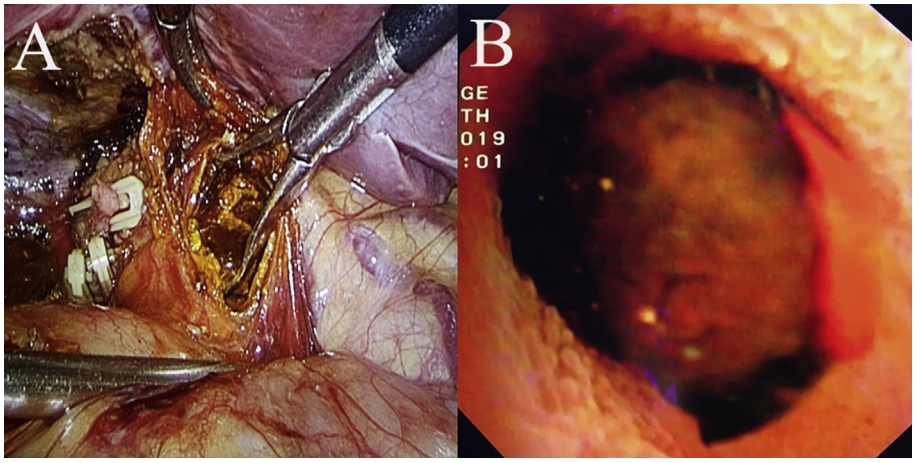

Figure 1 Common bile duct stones removed by forceps, and choledochoscopy. A: The common bile duct was dissected at a distance of 1.0—1.5 cm from the upper edge of the duodenum, Stone pliers were directly inserted into the common bile duct, and the relatively large stones were clamped. B: Choledochoscopy was performed to evaluate the distribution of stones at the lower end of the bile duct.

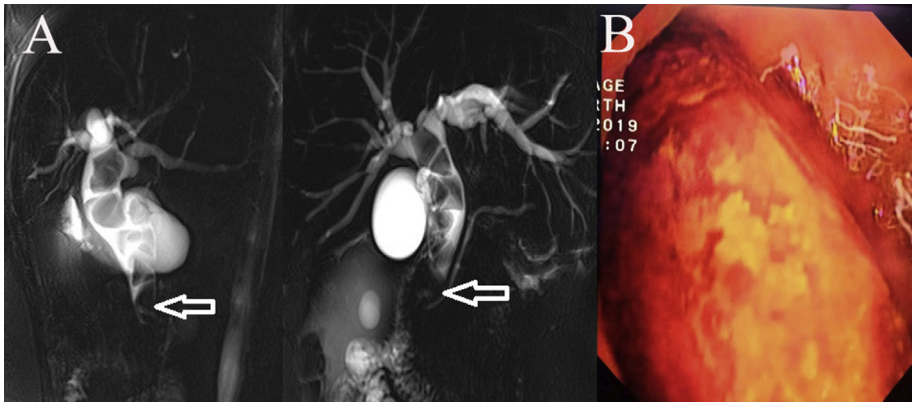

Figure 2 Incarcerated choledocholithiasis at the lower end of bile duct. A: MRCP showed multiple stones in the bile duct and incarceration of stones at the lower end of the bile duct (Arrow); B: Fibercholedochoscopy revealed incarceration stone with the wall of the bile duct and inflammatory adhesion.

rinse with saline to maintain clear vision and heat dissipation. The above aspects were consistent with reports of other scholars.[7,8]

Moreover, when the pre-operative magnetic resonance cholangiography shows obvious curvature of the biliary tract, and the choledochoscope is estimated to be difficult to rotate, holmium laser lithotripsy should not be performed because the laser fiber is hard, and the corner angle is likely to cause bile duct damage. Second, it is necessary to infuse physiologic saline through the T tube after placing the T tube. So doing could help observe whether or not the bile duct wall suture is sufficiently tight to prevent bile leakage. Alternatively, edema of the right perirenal fascia and omentum can be monitored. When edema is observed, it can be further confirmed by administering methylene blue from the T tube to determine whether or not there is a penetrating injury to the bile duct. If there are any of the above manifestations, conversion to open laparotomy is the best strategy.

In conclusion, for incarcerated choledocholithiasis, the combination of holmium laser and fiber choledochoscopy in LCBDE dramatically improves the success rate of stone removal.

Conflict of interest

The authors declared no competing interests.

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