Case report: Biliary lithotripsy for hepatolithiasis in a patient with hepato-jejunal anastomosis

A 58-year-old patient presented worsening right upper quadrant pain and fever with elevated serum hepatic enzymes. His surgical history was significant for a cholecystectomy and subsequent hepato-jejunostomy. MRI and cholangiography showed diffuse dilatation of intra and extra hepatic bile ducts with multiples intraductal biliary stones especially in the left liver. Endoscopic Retrograde CholangioPancreatography (ERCP) was unsuccessful due to extensive operative history and surgical intervention carried a high mortality risk. Percutaneous biliary drainage was performed which helped resolve the patient's symptoms, but definite treatment was still required, especially that overpassing a stone on the right side was not possible after many attempts. Percutaneous endoscopic Holmium laser lithotripsy was performed with successful fragmentation of the stone and clearance of the obstruction, without complication. The endoscope was used to help visualize the narrowed anastomosis and to advance a guide wire into the jejunal lumen, allowing internal-external tube placement on the right side. This case is relevant to the growing literature on the management of refractory biliary stones using laser lithotripsy after failed ERCP.

KEYWORDS: Holmium laser ▪ Percutaneous lithotripsy ▪ Interventional radiology ▪ Biliary intervention ▪ Choledocholithiasis

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Introduction

Endoscopic Retrograde Cholangio Pancreatography (ERCP) is the preferred therapeutic management method for managing biliary obstruction in patients with bilio-enteric anastomotic strictures and calculi. In patients whose duodenal anatomy is altered following upper gastrointestinal tract surgery, ERCP is technically challenging and often impossible. These patients are usually poor candidates for surgical management due to sepsis and other comorbidities. Advanced endoscopic therapies like balloon-enteroscopy or rendevous-ERCP may be considered but are not always feasible.

Percutaneous radiological stone extraction is the last therapeutic option for the small number of patients in whom endoscopic techniques are unsuccessful or impossible. Biliary access is usually achieved by percutaneous transhepatic cholangiography drain. A less commonly reported procedure is percutaneous transhepatic cholangioscopy and lithotripsy which uses percutaneous biliary access for duct clearance under video cholangioscopy guidance with lithotripsy as an adjunct for stone fragmentation.

Case Presentation

A 58-year-old patient presented with worsening Right Upper Quadrant (RUQ) pain and fever with elevated serum hepatic enzymes.

The medical and surgical history of the patient were significant for a cholecystectomy with subsequent hepato-jejunostomy and "Roux en Y" procedure 15 years prior to the presenting symptoms, secondary to an episode of angiocholitis complicating an impacted stone in the common bile duct (**FIGURE 1**).

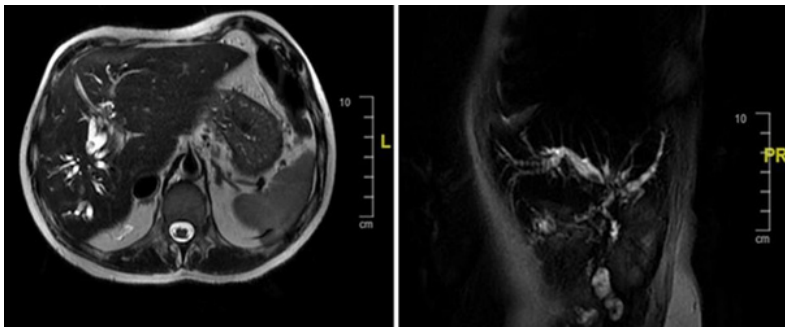

FIGURE 1. Hepatic MRI showing bile ducts dilatations and intraductal stones.

Ever since, the patient had multiple episodes of angiocholitis, which were treated with antibiotics and occasional surgical dilatation of the anastomosis. Before the actual presentation, the patient developed fever, chills and abdominal RUQ pain with elevated liver enzymes. Magnetic Resonance CholangioPancreatography (MRCP) was performed and showed diffuse dilatation of intra-hepatic and extra-hepatic bile ducts, upstream of a stenosis of the bilio-jejunal anastomosis with multiple intraductal stones, especially in the left liver, with an atrophy of the right liver.

Gastroenterologist considered ERCP to be unsuccessful due to the patient's postsurgical biliary anatomy, and surgical intervention carried a high mortality risk.

Percutaneous cholangiography was initially performed and showed a filling defect at the level of the right ductal anastomosis, considered to be secondary to an intraluminal stone, which was compatible with the MRCP findings.

Percutaneous biliary drainage was performed secondarily. An external biliary tube was inserted on the right hepatic lobe after many failed attempts to get past the stone and the anastomosis into the jejunal lumen. An internal-external biliary tube was inserted on the left hepatic lobe, after balloon dilation of a stenotic segment found on the left bile duct.

This procedure, along with the medical treatment, helped resolve the acute symptoms, but definitive treatment was still required.

After several attempts to overpass the right biliary duct stone into the jejunal lumen, we tried a "contre courant" approach from the left side, the stone couldn't be extracted and the anastomosis between the right biliary duct and the jejunum remained impassable.

The idea of percutaneous ablation of the stone from the right hepatic access into the bile ducts was raised and an urologist specialized in percutaneous lithotripsy was asked to help in performing the procedure, along with the interventional radiologist.

The patient was put under general anesthesia. The procedure started with exchanging the right external biliary drain with an Arrow introducer using a smooth guide wire which was then exchanged with a stiff wire that enabled the introduction of the flexible ureteroscope (LithoVue) into the biliary ducts (**FIGURE 2**).

The ureteroscope was advanced into the biliary tree toward the anastomosis under fluoroscopy and visual guidance, with repeated injection of contrast into the biliary tree via the Arrow introducer to better determine the anatomy, the LithoVue system requiring permanent flushing with normal saline for better visualization.

After a short period, the ureteroscope was advanced toward the anastomosis and the stone was visualized. Once in direct contact, the stone was fragmented using a holmium laser light into small pieces that were cleaned with the flushing system.

Once the stone was cleared, the ureteroscope helped the visualization of the anastomosis, and was used as an introducer to advance a guide wire across the narrowed anastomosis into the jejunal lumen, and the ureteroscope was slowly and delicately removed while ensuring the wire remained in place with fluoroscopy (**FIGURE 3**).

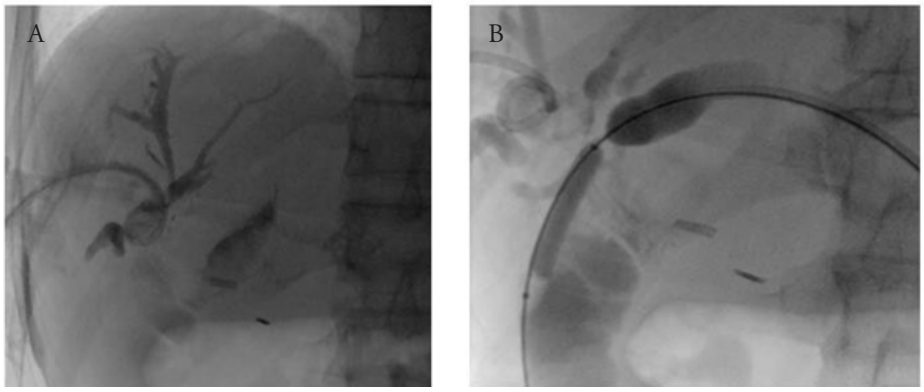

FIGURE 2. (A)External percutaneous biliary drainage on the right biliary system with visualized intraluminal defect compatible with the stone. (B) Balloon dilation of the left hepato-jejunal anastomosis with guide wire in the jejunal lumen.

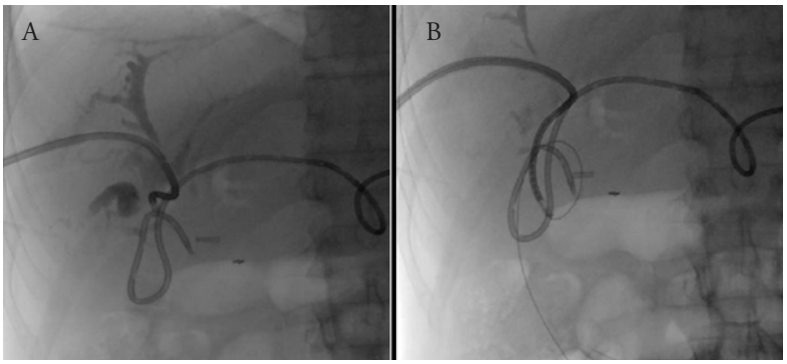

FIGURE 3. (A) Ureteroscope in the right biliary ducts in the contact of the anastomosis while using the laser to destroy the stone. (B) Ureteroscope across the anastomosis with a guide wire in the jejunal lumen on the right image.

A control cholangiography through the main arrow introducer showed a mild dilation of right biliary tree, without the visualization of any stone. The anastomosis was permeable and contrast material diffused easily into the jejunum. The introducer was finally exchanged with an internal-external biliary drain.

The patient showed marked improvement of his symptomatology and his liver enzymes. Three days later, he was discharged home with instructions to return to the emergency room if fever, jaundice or severe abdominal pain returned.

Two weeks after the procedure, a control cholangiography was performed, and showed a major regression of the biliary dilation, without any visible intraluminal defect, and a patent anastomosis on both sides. The biliary drains were then both removed (**FIGURE 4**).

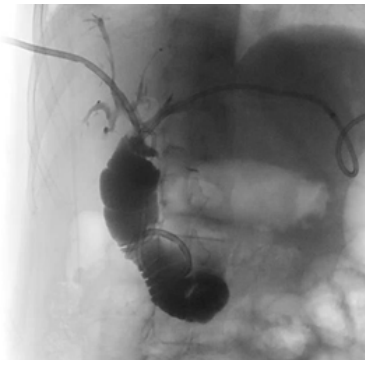

FIGURE 4. Cholangiography two weeks after the procedure.

Discussion

Gallstone and biliary diseases continue to be a major health problem, affecting approximately 10 to 20 percent of the Caucasian population. Ten percent of these patients have gallstones in their biliary ductal system which, in most cases, can be removed endoscopically [1].

Extracting gallstones that are not easily removable using standard methods can be challenging. Large stones lodged within the bile duct require fragmentation before they can be removed. These stones were traditionally fragmented using mechanical extracorporeal lithotripsy, which is successful in approximately 90% of patients. In the remaining 10 percent, gallstones resist conventional fragmentation due to size (>2 cm), consistency (eg, bilirubin stones), anatomical position (eg, impaction), or accessibility (eg, intrahepatic stones) [2,3].

A variety of methods have been conceived for extraction of intraductal stones. A systemic review of 32 studies conducted in 2017 on advanced lithotripsy for retained biliary tract stones showed that laser lithotripsy was the most successful form of advanced lithotripsy for biliary tract stones after conventional endoscopy. Laser lithotripsy had a 95% ductal clearance rate and a 10% overall morbidity rate, with no mortality reported [4].

Laser lithotripsy permits precise targeting, thereby reducing the risk of bile duct injury. In addition, this technique may be suitable for unusual clinical situations including disintegrating intraductal stones impacted in

a Dormia basket [5], performing lithotripsy under fluoroscopic control in patients who have undergone a Billroth II gastrectomy [6], and managing Caroli disease [7].

One large clinical study using a Holmium laser in 69 patients with choledocholithiasis was conducted in 2014. Among these patients, the biliary stones were successfully removed in 67 of cases. The complication rate in this study was 4.1% (2 patients experienced minor bleeding and 1 patient developed mild post- ERCP pancreatitis) [8].

The principle of laser lithotripsy is the generation of a high-energy shock wave capable of fragmenting intraductal gallstones [9].

The continuous-wave lasers (eg, cw-Nd: YAG) were inefficient for stone fragmentation because they caused drilling effects in the gallstones and thermal melting instead of lithotripsy. Pulsed laser systems reduce the risk of thermal injury significantly since power peaks may reach the gigawatt range (10 billion W), but only for fractions of a second. The physical properties of the lasers are determined by several factors, namely wavelength, pulse width, and energy. These factors influence the particular laser beams effect on tissue and stones. Some lasers, such as CO2 (wavelength, 10,600 nm), demonstrate shallow depth of penetration (0.1 mm) and are effective at ablation or incision. Lasers with shorter wavelengths, such as Nd: YAG (wavelength, 1064 nm) penetrates tissue more deeply (05 mm) and provides significant coagulation and thermal effects [8].

The Ho: YAG laser has a wavelength of 2140 nm, which is very near the wavelength of water (1940 nm). This property of holmium is responsible for many of its favorable attributes. The tissue penetration of Ho: YAG is 0.5 mm as opposed to 5 mm with Nd: YAG. Holmium demonstrates both the ablative effects of CO_2 upon direct contact with the target and coagulation effects of Nd: YAG when at a slight distance from the target. Holmium is absorbed 60 times more readily in water than Nd: YAG, making it extremely safe for stone fragmentation in an aqueous media [8].

Furthermore, accessing the distorted biliary anatomy can sometimes be challenging, especially in the case of the presence of an anastomotic stricture or stones. A recent case report showed the benefit of a single-use flexible endoscope for direct visualization and consequent catheterization of an anastomosis stricture.

During this procedure, we used the flexible single-use ureteroscope in association with the holmium: YAG laser, which is considered the preferred options for biliary lithotripsy, in order to treat the intraductal stones and access the difficult anastomosis with direct visualization.

We chose a 9.5-Fr Lithovue flexible disposable endoscope which offers an affordable solution to perform endoscopy during routine procedures. The LithoVue 3.6-Fr inner working channel allows the use of most guidewires, snares, and microcatheters, as well as several endoscopic tools. The setup is simple. There is a single cable connection point with a built-in light source to a portable, proprietary digital monitor (Boston Scientific) and a side port for infusion of pressurized normal saline to improve visualization. The single use endoscopes cost roughly $1500.

During urological procedures, disposable single use ureteroscopy has been reported to facilitate traversal of a pyelovesicostomy stricture, which could not be traversed fluoroscopically. We used the Lithovue for fragmentation of the stone and to search for the biliary anastomosis. In this case report, had a disposable endoscope not been used, the anastomosis could not have been traversed, and the patient would have been left with an external right biliary drain above the biliary anastomosis [10].

Conclusion

This minimally invasive percutaneous ureteroscopy and laser lithotripsy obviated the need for an open procedure. As shown by Patel *et al.* and other reports in the growing Urologic literature, gallstone lithotripsy using a holmium laser can be a reasonable and safe alternative for many patients. The interventional radiologist plays an active role in these cases. This case is relevant to the growing literature on the management of refractory biliary stones.

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