ORIGINAL ARTICLE

Successful endoscopic laser lithotripsy in 2 cases of Bouveret syndrome and cholecystocolonic fistulae–induced colonic obstruction: a minimally invasive approach

Eduardo A. Vega, MD,[1] Belen Rivera, MD,[2] Carlos Harz, MD[3]

BACKGROUND

Bouveret syndrome, although rare (occurring in only 0.3%-0.5% of cases), represents a severe adverse event of cholelithiasis.[1] This condition is characterized by the occurrence of gastric outlet obstruction due to the migration of a large gallstone through cholecystogastric or cholecystoduodenal fistulae, ultimately resulting in stomach or duodenal obstruction. Another uncommon but noteworthy adverse event associated with gallbladder disease is the formation of cholecystocolonic fistulae (with an incidence ranging from 0.06% to 0.14%).[2] These fistulae are often asymptomatic or may manifest as diarrhea, stemming from the passage of bile acids bypassing the enterohepatic recirculation in the terminal ileum.[2] Less frequently, cholecystocolonic fistulae can lead to large-bowel obstruction. Although surgical intervention has traditionally been the primary treatment approach,[1] recent developments have highlighted the advantages of less invasive endoscopic methods, which offer shorter recovery times.

This article presents 2 successful cases of endoscopic treatment for Bouveret syndrome and cholecystocolonic fistulae leading to large-bowel obstruction. Both cases are from Clínica Santa María, Santiago de Chile. Successful treatment of Bouveret syndrome with holmium laser lithotripsy has been previously documented.[3-6]

All patients provided written informed consent before commencement of the study. There was no need for approval by our institutional review board.

Abbreviations: EHL, electrohydraulic lithotripsy; ESWL, extracorporeal shockwave lithotripsy.

2468-4481
https://doi.org/10.1016/j.vgie.2024.03.001

Department of Surgery, St. Elizabeth's Medical Center, Boston University School of Medicine, Boston, MA (1), Faculty of Medicine Universidad del Desarrollo, Clínica Alemana de Santiago, Santiago, Chile (2), Department of Surgery, Clínica Santa María, Santiago, Chile (3).

CASE 1 AND TECHNIQUE

A 75-year-old woman presented a history of 1.5 months of colicky abdominal pain associated with occasional vomits that relieved pain. Esophageal endoscopic examination demonstrated 20-mm calculous impacted in the duodenum bulb, due to a cholecystoduodenal fistulae generating a secondary pillory syndrome. The patient was hospitalized due to pyloric syndrome, and the diagnosis was confirmed with endoscopy and abdominal CT scan (Figs. 1 and 2). A holmium laser generator (Lumenis, Yokneam, Israel) was used with settings of energy at 1.4 J, frequency at 15 Hz, and power at 24 W. The calculous was successfully fragmented and irrigation was used to clear debris (Fig. 3). The fistulous connection was visualized, and at close inspection the lumen of the gallbladder showed no calculous. The gallbladder wall was part of the duodenal wall. Larger fragments were removed proximally with a Dormia (Coloplast Corp, Minneapolis, Minn, USA) basket, and smaller pieces of gallstone passed spontaneously into the distal duodenum. Contrast dye was injected, contrasting the gallbladder remnant and the duodenum, advancing distally with facility, and showing no extravasation and no contrast to the bile duct. The total duration of the procedure was 45 minutes. The patient recovered successfully with full resolution of symptoms. Twenty-four hours after the procedure, a magnetic resonance cholangiography of control demonstrated no choledocholithiasis, and liquid diet was introduced and well tolerated. The patient was discharged 48 hours after the procedure. There were no adverse events reported within 30 days or during 1-year follow-up. The remaining defect of the fistula was left open and closed spontaneously. Follow-up with endoscopy at 2 months showed a partially closed fistula (Fig. 4), and at 8 months it was completely closed. The fistula was not surgically closed, as the gallbladder formed part of the duodenal wall and the tissue was inflamed and fragile. Furthermore, the same inflammatory process subsequently tends to heal and forms a scar.

CASE 2 AND TECHNIQUE

An 87-year-old woman with multiple comorbidities including arterial hypertension, atrial fibrillation, diverticular disease, and cholelithiasis presented with diffuse abdominal pain and abdominal distention associated with nausea and

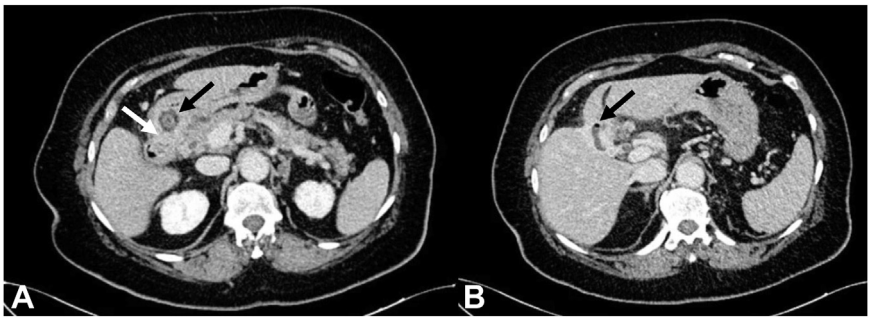

Figure 1. Axial cut of abdomen CT scan showing gallstone (*black arrow*, **A**) within the duodenum, a cholecystoduodenal fistula (*white arrow,* **A**), and pneumobilia in the gallbladder lumen (*black arrow,* **B**).

Figure 2. Coronal cut of abdomen CT scan showing a gallstone (*black arrow*) within the duodenum.

obstipation for 4 days. Abdominal CT scan was compatible with gallstone ileus, demonstrating the presence of a giant gallstone of 35 mm in diameter impacted in the distal segment of the sigmoid colon (Fig. 5). After a multidisciplinary discussion, endoscopic therapy was decided, given the age and comorbidities of the patient. The endoscope was introduced up to the sigmoid where multiple diverticula were evident, which deformed and decreased the diameter of the lumen. A large impacted calculous was recognized, and treatment was proceeded with Odyssey 30 holmium laser (Cook Medical, Bloomington, Ind, USA) lithotripsy (940-µm core diameter fiber) at a power of 30 W, fragmenting the stone until disimpacted. Later, mechanical lithotripsy was performed, achieving greater fragmentation of the calculous; however, it was not feasible to extract due to the deformation and relative stenosis of the sigmoid. Once again, laser lithotripsy was done, and subsequently, another 3 mechanical lithotripsies were performed with which the extraction of all the fragments was achieved with a Roth net (Steris, Mentor, Ohio, USA). Finally, a colonoscopy was accomplished until the cholecystocolonic fistulae was recognized (Fig. 6). The procedure lasted 150 minutes. Surgical closure of the fistulae was not attempted after endoscopy due to the patient's multiple and previously known comorbidities. The patient remained asymptomatic from a digestive point of view. No subsequent surgical management was needed, and the patient was hospitalized for a total of 6 days, as she had multiple comorbidities. Cholangioresonance of control showed no stones in the biliary tract. Two years later she presented with choledocholithiasis, managed endoscopically. The last follow-up was done 5 years from the first endoscopic intervention; the patient was asymptomatic from a digestive point of view with normal liver tests but died that same year due to heart failure.

RESULTS AND DISCUSSION

Bouveret syndrome can be treated with open surgery or endoscopic approach. Endoscopy is the preferred initial choice due to its lower associated morbidity and mortality rates (1.6% vs 17.3%).[7]

Endoscopic methods encompass both retrieval and lithotripsy techniques, including mechanical, electrohydraulic (EHL), or laser lithotripsy, to eliminate obstructing gallstones. Endoscopic retrieval is more effective for smaller calculi, whereas gallstones exceeding 2 to 2.5 cm in diameter often require lithotripsy for safe passage through the lower GI tract or safe removal.[1,8] Although endoscopy offers a less invasive initial treatment choice, the success rate of the procedure depends largely on the technique used (mechanical, EHL, or laser lithotripsy) and the experience of the team. Ong et al,[8] in a systematic review of 154 articles, demonstrated that the overall success rate is 37%-43%, with a single-mode therapy success rate of 29%, bimodal therapy success rate of 54%, and multimodal therapy success rate of 56%. When using laser lithotripsy plus other lithotripsy mode in less than 4-cm stones, the success rate is 100% of the cases. Failure of endoscopic therapy is associated with increasing gallstone length ($P < .0001$) and

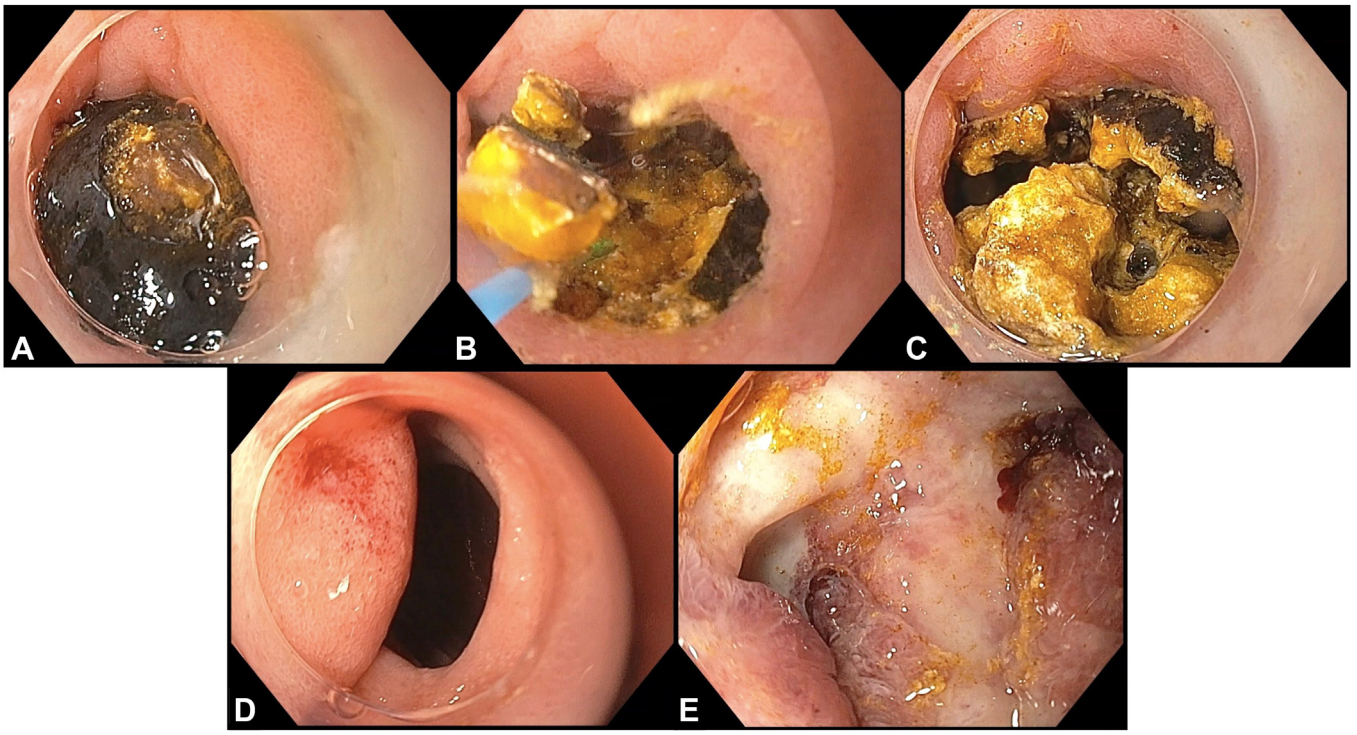

Figure 3. Endoscopic view of 20-mm gallstone obstructing the pylorus at the opening of a fistulous tract (**A**). Holmium laser lithotripsy of the gallstone (**B**), fragmentation of the gallstone (**C**), and complete clearance of the cholecystoduodenal fistula (**D** and **E**).

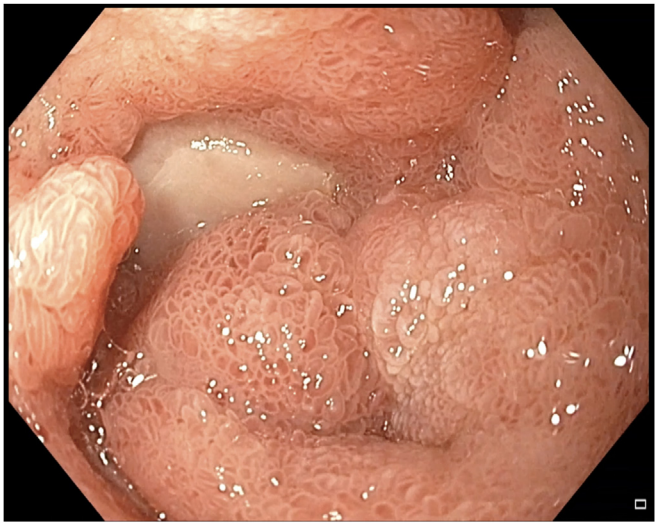

Figure 4. Endoscopic control of the cholecystoduodenal fistula 2 months later.

impaction in the distal duodenum ($P < .05$). Using multiple endoscopic modalities is associated with better success rates ($P < .05$). This highlights the importance of selecting appropriate techniques and having a skilled team to maximize treatment efficacy.

Holmium laser lithotripsy works at a wavelength that is actively absorbed by water, limiting the depth of the laser penetration and surrounding tissue damage.[9] There is one case report of duodenal erosion following bilateral rigid ureteroscopy with holmium laser lithotripsy.[9] To our knowledge, there are no reports of GI erosion, ulcerations, or bleeding related to the use of holmium laser lithotripsy in the management of biliary disease. Moreover, with the distal attachment cap (Olympus, Tokyo, Japan), the endoscope is kept stable when resting on the stone; the laser tip can be in direct contact with the calculous; stone displacement is reduced following the laser pulse compared to EHL; and there is a safe distance between the laser and the endoscope to avoid damage to the latter. Finally, by reducing the displacement of the stone and the endoscope being supported on it, the risk of damaging the adjacent tissue and unexpected displacement that can result in an adverse event is also diminished.

Despite limited data evaluating and comparing safety and efficacy between techniques, based on our experience, the fragmentation of gallstones with holmium laser lithotripsy is more effective (fragmentation of the calculous has been 100%) and faster than EHL, as the number of shots required are less. Added to this, EHL fibers are more fragile and come with a limited number of shots; therefore, its useful life is shorter compared with holmium fibers that are more flexible and reusable.

Regarding the settings for use, holmium laser can be delivered through air, saline, or blood.[10] The laser should be used under irrigation to avoid local thermal effect. Also, the use of a liquid medium, such as saline, helps to achieve better visibility and to clean the field. It has been demonstrated with animal models that the laser does not cause eye damage at more than 5 cm of distance in the absence

Figure 5. Coronal cut of abdominal CT scan showing the impacted gallstone in the sigmoid colon (*white arrow,* **A**). Axial cut of abdominal CT scan that demonstrates cholecystocolonic fistula (*black arrow*) and dilated bowel loops with presence of fluid levels (**B**).

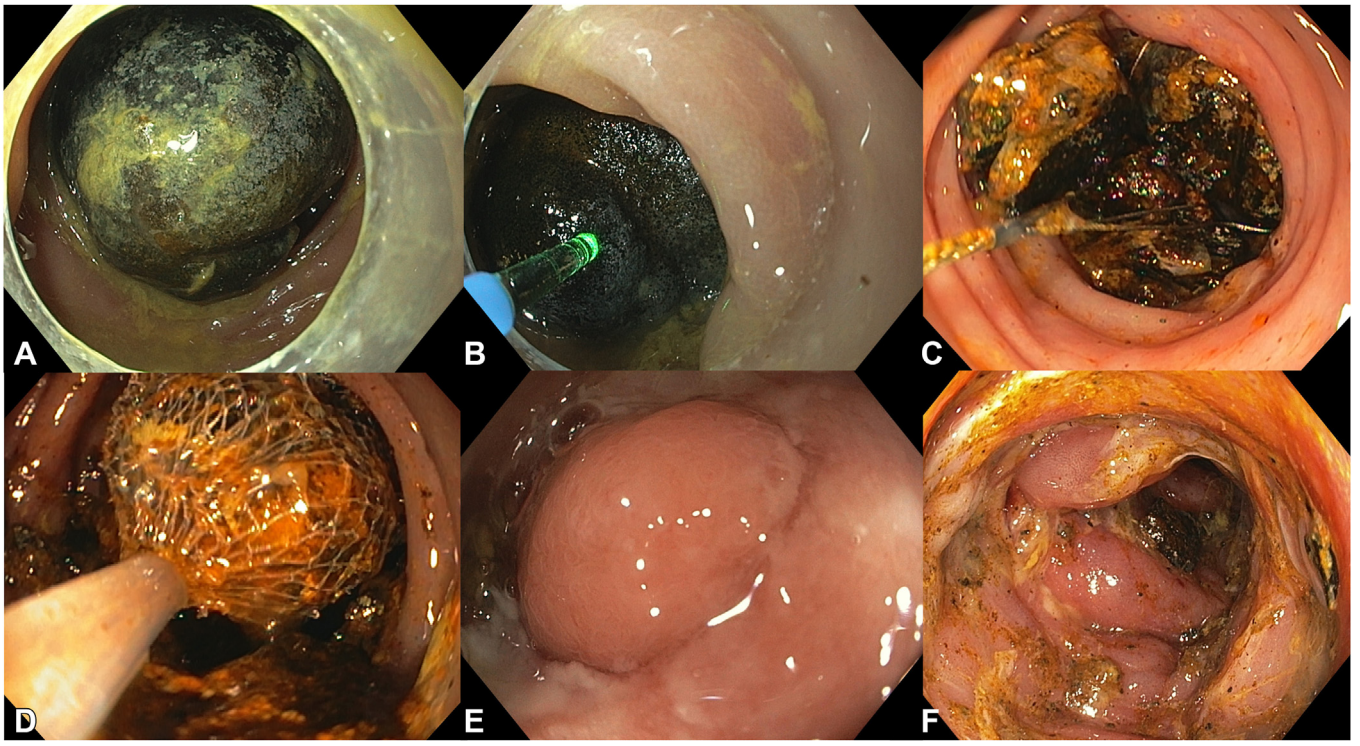

Figure 6. Endoscopic view of gallstone impacted on sigmoid colon treated with holmium laser and mechanical lithotripsy (**A-C**). Extraction of fragments with Roth net (**D**), cholecystocolonic fistulae (**E**), and defacement at calculous impaction site (**F**).

of eye protection, regardless of the laser setting or exposure time.[11] Training is done with urologists, and they assist as consults in every GI procedure the laser is used.

Although isolated instances of Bouveret syndrome treated with extracorporeal shockwave lithotripsy (ESWL) have been reported, most have yielded unfavorable outcomes. ESWL may be considered when gallstone accessibility is challenging but often necessitates multiple sessions.[12] Presently, no studies definitively determine the most effective endoscopic modality.[8]

In cases in which endoscopic therapy proves unsuccessful, surgery typically becomes the recommended course of action. Surgical intervention, along with cholecystectomy and closure of cholecystoenteric fistulae, is generally reserved for healthy, younger patients in whom the risk of recurrence outweighs the surgical risks.[13] The closure of cholecystoenteric fistulae is frequently considered unnecessary, as spontaneous closure may occur, especially in the absence of residual stones.[14]

Successful endoscopic treatment of colonic gallstone ileus has been documented using mechanical lithotripsy, EHL, and ESWL.[15-17] As far as our knowledge extends, this is the first case report of successful endoscopic treatment using laser lithotripsy for colonic gallstone ileus.

Within the limitations of the endoscopic procedure for Bouveret syndrome and gallstone ileus is the fact that the equipment may not be readily available in all medical settings. Also, cases are very rare, and the experience that endoscopists have using holmium laser in Bouveret syndrome or gallstone ileus is low. Patients with these pathologies could be referred to centers with endoscopists that are acquainted with the use of holmium laser in digestive procedures and thus centralize the cases and increase the experience of these specialists.

In conclusion, management of Bouveret syndrome and colonic gallstone ileus presents a complex array of treatment options, with endoscopic approaches playing a pivotal role. Notably, the use of holmium laser lithotripsy has demonstrated effectiveness and safety, as evidenced by the limited but promising cases reported in the literature. When successful extraction of the obstructing gallstone is achieved, our recommendation is to consider this as a viable alternative to a mandatory interval cholecystectomy. This approach not only spares patients the risks associated with surgical intervention but also offers a minimally invasive and efficacious means of resolving these challenging conditions. Further research and comprehensive studies are needed to establish laser lithotripsy's long-term outcomes and its place as a preferred treatment option in the management of these rare but serious clinical entities (Video 1, available online at www.videogie.org).

DISCLOSURE

The authors disclosed no financial relationships relevant to this publication.

REFERENCES

1. Turner AR, Kudaravalli P, Al-Musawi JH, et al. Bouveret syndrome (bilioduodenal fistula). Treasure Island, FL: StatPearls Publishing; 2024.
2. Balent E, Plackett TP, Lin-Hurtubise K. Cholecystocolonic fistula. Hawaii J Med Public Health 2012;71:155-7.
3. Senra Lorenzana FS, Navaratne L, Liasis L, et al. Endoscopic holmium laser lithotripsy (EHLL) as an alternative minimally invasive therapy to the surgical management of Bouveret syndrome. Indian J Surg 2023;85:131-4.
4. Jaroenlapnopparat A, Demirjian AN, Brugge WR, et al. A case of Bouveret's syndrome treated with holmium:yttrium-aluminum-garnet laser. Cureus 2023;15:e37258.
5. Silva-Santisteban A, Mehta N, Trasolini R, et al. Endoscopic holmium laser lithotripsy for therapy of Bouveret syndrome. VideoGIE 2023;8:115-7.
6. Allen R, Johnston CJC, Thomasset S, et al. Endoscopic management of Bouveret syndrome with electrohydraulic lithotripsy. VideoGIE 2023;8:464-8.
7. Dumonceau JM, Devière J. Novel treatment options for Bouveret's syndrome: a comprehensive review of 61 cases of successful endoscopic treatment. Expert Rev Gastroenterol Hepatol 2016;10:1245-55.
8. Ong J, Swift C, Stokell BG, et al. Bouveret syndrome: A systematic review of endoscopic therapy and a novel predictive tool to aid in management. J Clin Gastroenterol 2020;54:758-68.
9. Pabla B, Morgan DR. Duodenal ulceration following holmium laser lithotripsy. Case Rep Gastroenterol 2019;13:12-6.
10. Verret DJ, Jategaonkar A, Helman S, et al. Holmium laser for endoscopic treatment of benign tracheal stenosis. Int Arch Otorhinolaryngol 2018;22:203-7.
11. Villa L, Cloutier J, Compérat E, et al. Do we really need to wear proper eye protection when using holmium:YAG laser during endourologic procedures? Results from an ex vivo animal model on pig eyes. J Endourol 2016;30:332-7.
12. Caldwell KM, Lee SJ, Leggett PL, et al. Bouveret syndrome: current management strategies. Clin Exp Gastroenterol 2018;11:69-75.
13. Alemi F, Seiser N, Ayloo S. Gallstone disease: cholecystitis, Mirizzi syndrome, Bouveret syndrome, gallstone ileus. Surg Clin North Am 2019;99:231-44.
14. Ali IA, Mahmood S, Tierney WM. Bouveret syndrome: a tough nut to crack. VideoGIE 2019;4:126-7.
15. Zielinski MD, Ferreira LE, Baron TH. Successful endoscopic treatment of colonic gallstone ileus using electrohydraulic lithotripsy. World J Gastroenterol 2010;16:1533-6.
16. Augustin G, Bruketa T, Kunjko K, et al. Colonic gallstone ileus: a systematic literature review with a diagnostic-therapeutic algorithm. Updates Surg 2023;75:1071-82.
17. Turner AR, Sharma B, Mukherjee S. *Gallstone Ileus*. Treasure Island, FL: StatPearls Publishing; 2024.