Gallstone Ileus. What therapeutic options are there?

Ann Ital Chir, 2022 93, 3: 300-306
pii: S0003469X2203723X
Online ahead of print 2022 - Jan. 28
free reading: www.annitalchir.com

Alin Mihai Vasilescu*, Eugen Tarcoveanu*, Costel Bradea*, Cristian Lupascu*, Franco Stagniti**

**First Surgical Clinic, St. Spiridon University Hospital, "Grigore T. Popa" University of Medicine and Pharmacy Iasi, Romania*
***Polo Pontino "La Sapienza" University of Rome, Rome, Italy*

Gallstone Ileus. What therapeutic options are there?

Gallstone ileus is a rare disorder in emergency surgical practice with diagnosis usually difficult and only achieved at surgery. The current approaches are: enterolithotomy, cholecystectomy and fistula repair (one-stage surgery), enterolithotomy with cholecystectomy performed later (two-stage surgery) and only enterolithotomy (most reported surgical procedure). Methods: The clinical, operative and follow-up data on 14 consecutive patients treated in our clinic for gallstone ileus was retrospectively reviewed. Results: Gallstone ileus was recorded in 0.06% of all operations for biliary lithiasis and 1% of all enteric occlusions. There were 11 women and one men, with a mean age of 77.3 (range 67-100) years. There was a mean delay of 3.16 days for onset of symptoms to admission. Urgent laparotomy confirmed gallstone obstruction and a cholecysto-duodenal fistula (13 cases) or cholecysto-colonic fistula (1 case). We performed one stage surgery in 4 cases, enterolithotomy alone in 8 cases (one case operated initially in another surgical service), Hartman procedure, cholecystectomy and fistula repair in one case and a spontaneous evacuation of the gallstone with cholecystectomy and fistula repair later in another case. We recorded 2 deaths in patients with multiple comorbidities in which only enterolithotomy was performed and with 1 and 2 reinterventions, respectively. Postoperative stay was 9.4 days for cases with simple enterolithotomy and 18.6 days for cases with radical treatment. We did not record any recurrence. Conclusions: Although rarely encountered in surgical practice, gallstones ileus should be noted in the differential diagnosis of intestinal obstruction in patients with a past history of biliary disease, occlusive syndrome, pneumobilia and possibly ectopic gallstone. The one-stage procedure should be the offered to stabilized patients, but in cases with associated comorbidities, only enterolithotomy represent a best option.

KEY WORDS: Gallstone ileus, Cholecystoduodenal fistula, Intestinal Obstruction

Introduction

Gallstone ileus is a rare condition in the practice of surgical emergencies, the occlusive syndrome produced by it, is a problem of diagnosis and surgical tactics. A rare form of mechanical occlusion, the ileus is caused by the impact of a gallstone on the digestive tract in the small bowel (the most common location being the terminal ileum) and extremely rarely in the colon; it is due to the passage of a stone through a bilioenteric fistula. Due to their low incidence, diagnostic suspicion and appropriate initial surgical treatment are of great importance for clinical evolution. Although rare in surgical practice, gallstone ileus must be retained in the differential diagnosis of intestinal occlusions in the elderly with a history of biliary, pneumobilia and possibly ectopic gallstone [1,2]. IB is an uncommon pathology, so there is a discrepancy as to the type of ideal surgical management, especially whether or not a biliary procedure should be associated with emergency enterolithotomy. The current approaches are: enterolithotomy, cholecystectomy and fis-

Pervenuto in Redazione Ottobre 2021. Accettato per la pubblicazione Novembre 2021
Correspondence to: Associate Prof. Bradea Costel, MD, PhD, First Surgical Clinic, St. Spiridon University Hospital,"Grigore T. Popa" University of Medicine and Pharmacy Iasi, Romania, Independentei str. no 1, 700111 Iasi, Romania (e-mail: bradeacostel@yahoo.com)

tula repair (one-stage surgery), enterolithotomy with cholecystectomy performed later (two-stage surgery) and only enterolithotomy (most reported surgical procedure) [3]. We perform a literature review on the current surgical management of IB and exemplify it by presenting a short series of patients.

Methods

Because the incidence of this condition has decreased recently, with the expansion of laparoscopic cholecystectomy in the treatment of gallstones, we have extended the study to over 20 years, between January 2001 to June 2021. The medical records of 14 patients who presented in the emergency in First Surgical Clinic at the St. Spiridon University Hospital Iasi were reviewed retrospectively. Ethical approval was obtained from the Ethics Committee of the hospital.

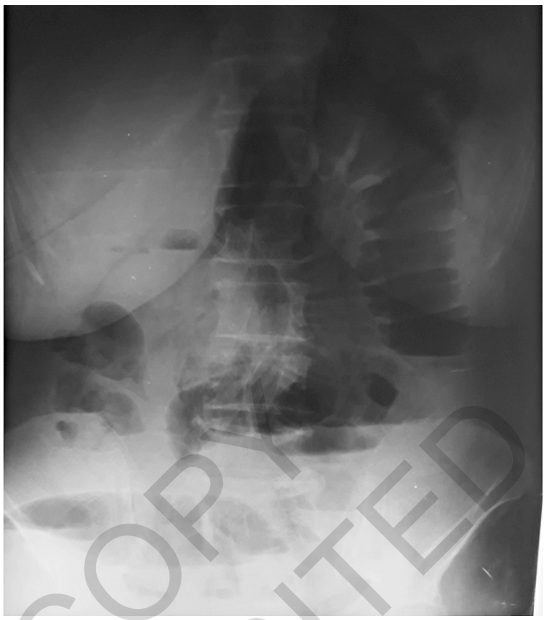

Fig. 1: Gallstone ileus: plain x ray abdomen – pneumobilia and hydroaerial levels.

Results

Gallstone ileus was recorded in 0.06% of all operations for biliary lithiasis and 1% of all enteric occlusions. In the studied group there were 13 women and one man. The mean age of the patients was 77.33 years (67-100 years).

The clinical appearance was intestinal occlusion in 11 cases, subocclusion and upper digestive hemorrhage in 1 case, localized peritonitis with Douglas abscess in 1 case and a female patient operated in another service for biliary ileus (syndrome Bouveret) with duodenal fistula and evisceration. We registered comorbidities in all cases: cardiovascular, hepatic, renal diseases, diabetes mellitus.

The onset-admission interval was an average of 3.16 days (1-5 days). From the history of the patients we retain the present untreated gallstones in 11 cases. All the patients hospitalized from the beginning in our clinic had suggestive hydroaerial levels for intestinal occlusion and pneumobilia at plain x ray abdomen (Fig. 1), abdominal ultrasound (Fig. 2) and CT exam (Fig. 3).

The treatment was medical, intensive preoperatively with hydroelectrolytic and acid-base rebalancing and surgery in emergency. Surgical exploration discovered cholecysto-duodenal fistula in 12 cases, cholecysto-colic fistula and Douglas abscess (sigmoid perforation determined by a 6x3 cm stone anchored at the recto-sigmoid junction, which caused colic necrosis) in 1 case and duodenal fistula with evisceration in a case (syndrome Bouveret initially operated in another service) with another biliary stone impacted at the level of the ileum.

Fig. 2: Gallstone ileus: abdominal ultrasound – pneumobilia (left) and scleroatrophic gallbladder with thickened walls and a 13 mm gallstone inside.

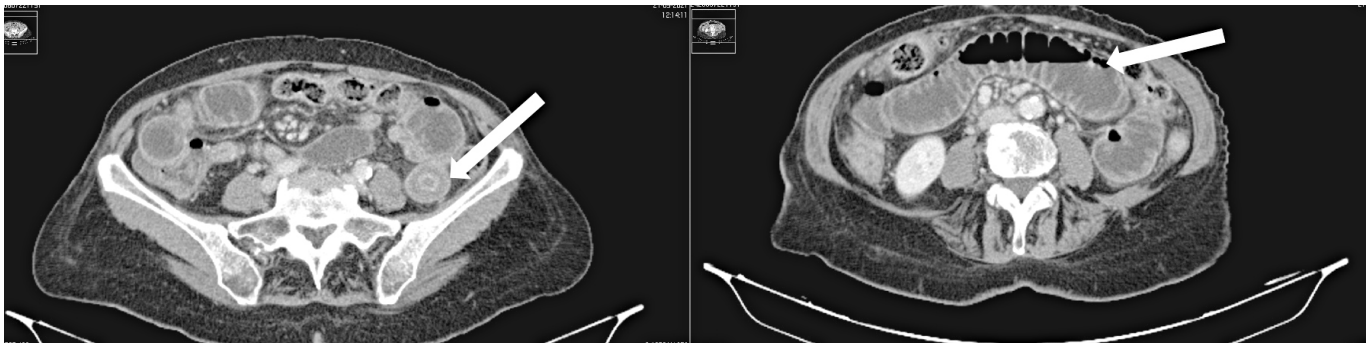

Fig. 3: Gallstone ileus: abdominal CT - Dilated segment of proximal small bowel (thin arrow) caused by migrated gallstone obstruction. Distal to the gallstone, small bowel loops are collapsed.

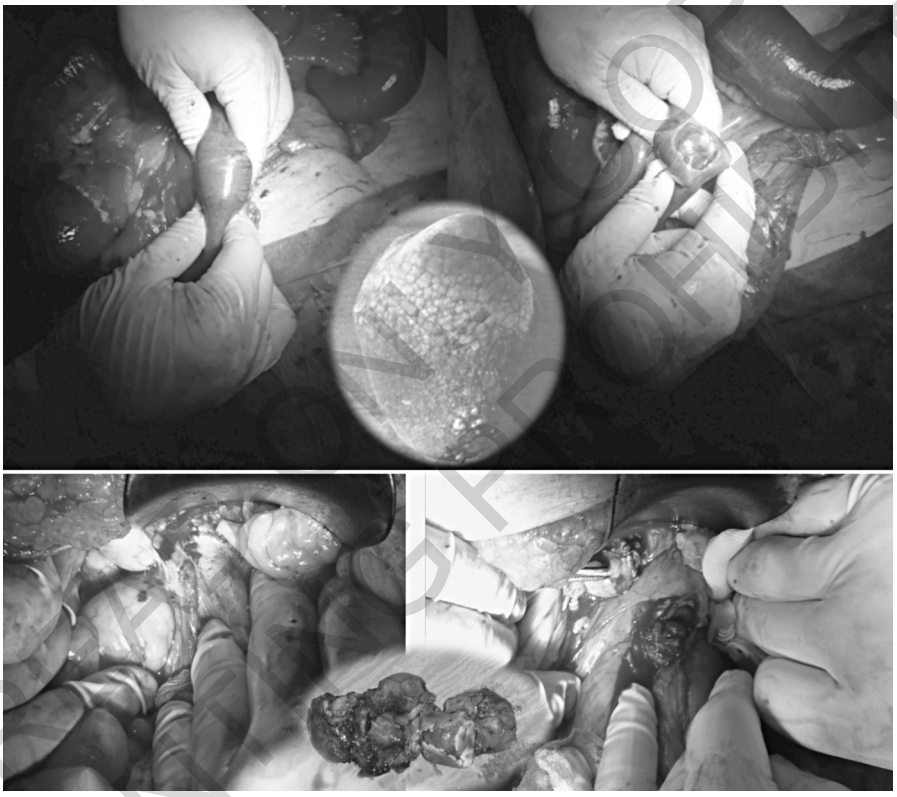

Fig. 4: Gallstone ileus: intraoperatory view - enterolithotomy with gallstone extraction, removal of the cholecystoduodenal fistula and cholecystectomy (the presence of another large gallstone is observed).

Gallstones associated were found in 4 cases. Location of obstruction was in the duodenum in 1 case, jejunum in 2 cases, ileum in 8 cases and sigmoid colon in 1 case (gallstone of 6 cm). The mean diameter of the biliary stone was 4.8 cm (range 2-6 cm).

Three patients in our case series were treated using minimally invasive video-assisted approach, in other cases due to the serious condition of the patient and surgeons' preference, the approach was started with a laparotomy. The surgical solutions chosen were: enterolithotomy, with abandonment of the cholecysto-duodenal fistula in 7 cases; enterolithotomy, cholecystectomy and closure of the bilio-digestive fistula in 4 cases (Fig. 4); a case with initial conservative treatment with spontaneous evacuation of a stone of 2 cm in the case admitted for digestive hemorrhage (it is observed on radiological examination with contrast the gallstone present in the cecum), cholecystectomy and closure of the biliary-digestive fistula at a later time during the same hospitalization; duodenostomy with a direct fistulization through a Pezzer probe and gastroenteroanastomosis, on which occasion another gallstone is found anchored in the terminal ileum that determines occlusion for which we performed enterolithotomy and enteroraphy (patient with syndrome Bouveret

operated initially in another service); Hartmann's procedure, cholecystectomy, closure of the cholecysto-colic fistula in 1 case.
The majority of this oldest patients were admitted postoperatively to the intensive care unit. The postoperative course was favorable in most cases but with long hospitalization especially in cases where we were forced to perform cholecystectomy with closure of biliodigestive fistula, patients being over 70 years, with multiple comorbidities, also requiring prolonged intensive care stay. Postoperative morbidity according Clavien-Dindo was: grade 1-3 cases (21.4%), grade 2-1 case (7.1%), grade 3-2 cases (14.2%) and 2 cases (14.2%) for grade 4.
We also recorded 2 deaths in patients with multiple comorbidities in which only enterolithotomy was performed and with 1 and 2 reinterventions, respectively.
Mean postoperative stay was 9.4 days for cases with simple enterolithotomy and 18.6 days for cases with radical treatment. We did not record any recurrence.

Discussion

Gallstone ileus is an exceptional complication of biliary lithiasis, occurs in 0.3-0.5% of cholelithiasis complications but with significant morbidity (30%) and mortality (20%) [1,2]. The incidence increases in direct proportion to the age of the patients. This pathology is more common in female patients because lithiasis is more common. The majority of patients are elderly women (>70%). The female/male ratio varies between 5/1 and 10/1, most patients are over 65 years old (as in our group) and preoperative diagnosis is made in less than half of cases with a recurrence rates by outstanding gallstone is 5% [3-5].
Bartholin made the first mention of the biliary ileus in 1654 in a necropsy study; in 1841 Bonnet describe the first case of duodenal obstruction; In 1890 Courvoisier publishes 131 cases of biliary ileus secondary to a cholecystoduodenal fistula and in 1932, Henry Huberrt Turner describes a colonic obstruction given by a calculation of 7.5 x 5.7 cm [1,6].
In our statistics there is a decrease in the incidence of biliary ileus in the era of laparoscopic cholecystectomy. It represents 0.08% of the 14,000 cholecystectomies and 1% of mechanical bowel obstruction operated in the same period in our clinic. Instead morbidity and mortality do not have changed significantly in the last 30 years [7].
How gallstones pass from the gallbladder to the digestive tract cholecystoduodenal fistula (most of cases), cholecystojejunal fistula and cholecystocolic fistula. The migration site can be: high (usually the duodenum, except the antrum or small bowel) and lower located (colon at the level of the hepatic angle).
In the literature we find described cases of biliary ileus after repeated endoscopic interventions or unsuccessful attempts to extract large stones. Most commonly, gallstones enter the digestive tract through a spontaneous biliary-digestive fistula. Abandoned peritoneal stones after laparoscopic cholecystectomy can reach in the digestive tract, but which does not fall within the pathological spectrum of biliary ileus - does not characterize the spontaneous evolution of gallbladder lithiasis [8].
The size of the gallstone must be at least 2 cm in diameter for the onset of the disease to determine obstruction [3,8]. The location of the obstruction can be high: duodenal - Bouveret syndrome, middle, jejuno-ileal or low at the level of sigmoid colon. The most common occlusion through gallbladder ileus is based on terminal ileum in 60-83% cases, Barnard's syndrome, manifesting itself as a classic intestinal occlusion, sometimes accompanied by jaundice (less than 15%) [1,3,9].
Diagnostic suspicion is clinically by the Mordor triad which includes known cholelithiasis diagnosis, clinical signs of acute cholecystitis and data consistent with intestinal obstruction [10]. The symptoms of biliary ileus are dominated by occlusive syndrome, complete or intermittent, called Karewsky syndrome, which is characterized by the chronic presence of intermittent abdominal pain, caused by the passage of gallstones to the intestine [11]. Colon involvement is much rarer, which is associated with sites of stenosis or narrowing secondary to inflammatory bowel disease [10].
History of gallstones is present in 60-70% of cases. In the elderly, the history may be irrelevant, the symptoms may be erased or hidden by associated diseases (cardiovascular, hepatic, renal) [1,3].
For paraclinical diagnosis the Riegler triad is used: pneumobilia - also known as aerobilia, is the accumulation of gas in the biliary tree (Gotta-Mentschler sign), intestinal distension with hydroaerial levels and ectopic gallstone (17-87% of cases) [8,10]. Imaging shows intestinal occlusion, vesicular changes, pneumobilia, cholecystoduodenal or cholecystocolic fistulas and even the level of impact of the stone. The most sensitive and specific imaging method in diagnosis is contrast-enhanced abdominal computerized tomography. The 'snake head like' appearance, Forchet sign, which is seen as a result of the obstruction of the bowel lumen due to the gallbladder, being unable of the contrast agent to pass the stone and accumulating there and Petren sign which is the passage of the contrast agent from the fistula tract to the gallbladder after giving oral contrast are also important radiological images for gallstone ileus [12].
The delay into the diagnosis of biliodigestive fistula and with the importance to suspect it or gallstone ileus presence, although the clinical presentation is extremely nonspecific. In Italian experience, cholangiopancreatography-CT have made easier the pre-operative diagnosis and so reducing the delay of the treatment [3].
The Rigler's triad, Forchet sign and Petren sign are pathognomonic for gallstone ileus.

As treatment methods can be extracted by endoscopic approach (gallstones anchored in the duodenum or colon) 9. Lafitte S report a case with transrectal endoscopic approach for gallstone [13].

The current surgical procedures are simple enterolithotomy and radical treatment with enterolithotomy, cholecystectomy and fistula closure (one-stage procedure) or sequential treatment with enterolithotomy with cholecystectomy and fistula closure performed later (two-stage procedure. The one-stage treatment has as a major disadvantage the prolongation of the operative time in an elderly patient, with metabolic imbalances and sepsis, in which the attempt to solve the bilio-digestive fistula requires a laborious dissection and a duodenal suture that is not performed in complete safety [1,14,15]. The "one stage" procedure is successful and majority of the patients survive even if they are affected by easily controlled complications [16]. Only enterolithotomy may later cause recurrent cholangitis, sepsis, or even gallstone ileus recurrence [17].

Laparascopy has changed the approach to this complication - treatment in one time or sequential of the biliary ileus and biliary-digestive fistulas. A mini laparotomy to perform an enterolithotomy can lead to a short operative time with minimal postoperative morbidity and early recovery [18-21]. Whatever it is the management of these patients in every case should be individualized, as there are many options, each with their own advantages and disadvantages.). Assali S describe a technical approach that facilitates safe laparoscopic examination of the entire small bowel and can be applied to other acute care surgery cases involving small bowel pathology [22]. Minimally invasive videoassited approach is a feasible option for the management of gallstone ileus and can decreased morbidity compared to laparotomy [23,24]. Zago M reported first case after biliointestinal bypass (BIB) for morbid obesity. preoperatively diagnosed through CT scan and US, and treated with a laparoscopic assisted approach [25].

There is a wide range of approaches to improving the obstruction described in the literature, relatively unusual approaches, such as shock wave lithotripsy, electrohydraulic lithotripsy and laser lithotripsy in Bouveret's syndrome using a new frequency doubled double pulse Nd: YAG laser to clinically available but still experimental methods [26-29]. The benefit of using laser lithotripsy is the precise targeting of energy onto the stone with minimal tissue injury. Endoscopic laser lithotripsy is a safe and feasible treatment option for Bouveret's syndrome comparative with electrohydraulic lithotripsy in which incidental focusing of the shock waves on the intestine wall may cause bleeding and perforation [30,31]. Balzarini M who performed successfully a mechanical lithotripsy and extraction of a large gallstone embedded in a sigmoid colon affected by diverticular stenosis recommend endoscopic approaches should be regarded as an effective and safe alternative to surgery [32].

For small gallstones, under 2 cm, can try conservative, non-operative treatment [33], as we did in one case.

Conclusions

Although the incidence of gallstone ileus seems to decrease in the era of laparoscopic surgery, the prognosis of the disease remains severe because it is associated with complications secondary to diagnostic delay and poor choice of initial surgical technique in elderly patients with multiple comorbidities, who ignore biliary distress and appear late for medical consultation. Surgical tactics will be individualized in each case one or two stage procedure. Although treatment is aimed at resolving intestinal obstruction by enterolithotomy and gallstone extraction can be life-saving in difficult cases, with an increased risk of anesthesia-surgery, there is controversy as to the preferred time to perform cholecystectomy and bilioenteric fistula repair, with two-stage surgery being the surgical procedure of choice. especially in patients at high risk of complications.

Riassunto

L'ileo da calcoli biliari è una malattia rara nella pratica chirurgica di emergenza con diagnosi solitamente difficili e generalmente solo realizzata durante l'intervento chirurgico. Gli approcci attuali sono: enterolitotomia, colecistectomia e riparazione di fistole (intervento chirurgico in un'unica fase), enterolitotomia con colecistectomia eseguita successivamente (intervento chirurgico in due fasi) e solo enterolitotomia (procedura chirurgica più segnalata).

Metodi: I dati clinici, operativi e di follow-up su 14 pazienti consecutivi trattati nella nostra clinica per ileo da calcoli biliari sono stati rivisti retrospettivamente.

Risultati: L'ileo da calcoli biliari è stato registrato nello 0,06% di tutte le operazioni per litiasi biliare e nell'1% di tutte le occlusioni enteriche: 11 donne e un uomo, con un'età media di 77,3 (range 67-100) anni. Si è registrato un ritardo medio di 3,16 giorni tra insorgenza dei sintomi e ricovero.

La laparotomia urgente ha confermato l'ostruzione di calcoli biliari e una fistola colecisto-duodenale in 13 casi, o una fistola colecisto-colonica (1 caso). Abbiamo eseguito un intervento chirurgico in una fase in 4 casi, la sola enterolitotomia in 8 casi (un caso operato inizialmente in un altro servizio chirurgico), procedura di Hartman, colecistectomia e riparazione della fistola in un caso e un'evacuazione spontanea del calcoli biliari con colecistectomia e riparazione della fistola successivamente in un altro caso.

Abbiamo registrato 2 decessi in pazienti con comorbilità multiple in cui è stata eseguita solo enterolitotomia e con 1 e 2 reinterventi, rispettivamente. La degenza

postoperatoria è stata di 9,4 giorni per i casi con enterolitotomia semplice e 18,6 giorni per i casi con trattamento radicale. Non abbiamo registrato alcuna ricorrenza.
CONCLUSIONI: Sebbene raramente riscontrati nella pratica chirurgica, i calcoli ileali dovrebbero essere individuati nella diagnosi differenziale di ostruzione intestinale in pazienti con una storia pregressa di malattia biliare, sindrome occlusiva, pneumobilia e possibilmente calcoli biliari ectopici. La procedura in uno stadio dovrebbe essere offerta ai pazienti stabilizzati, ma nei casi con comorbilità associate, solo l'enterolitotomia rappresenta l'opzione migliore.

References

1. Beuran M, Ivanov I, Venter MD: *Gallstone ileus. Clinical and therapeutic aspects*. J Med Life, 2010; 3(4):365-71.

2. Qasaimeh GR, Bakkar S, Jadallah K: *Bouveret's syndrome: An overlooked diagnosis. A case report and review of literature*. Int Surg, 2014; 99:819-23.

3. Stagnitti F, Tudisco A, Ceci F, Nicodemi S, Orsini S, Avallone M, Di Girolamo V, Stefanelli F, De Angelis F, Di Grazia C, Cipriani B, Aiuti F, Napoleoni A, Mosillo R, Corelli S, Casciaro G, Costantino A, Martellucci A, Spaziani E: *Biliodigestive fistulae and gallstone ileus: diagnostic and therapeutic considerations. Our experience*. G Chi, 2014; 35(9-10):235-38.

4. Halabi WJ, Kang CY, Ketana N, Lafaro KJ, Nguyen VQ, Stamos MJ, Imagawa DK, Demirjian AN: *Surgery for gallstone ileus: A nationwide comparison of trends and outcomes*. Ann Surg, 2014; 259(2):329-35.

5. Evola G, Caramma S, Caruso G, et al.: *Bouveret's syndrome as a rare complication of cholelithiasis: Disputes in current management and report of two cases.* Int J Surg Case Rep, 2020; 71:315-38. doi:10.1016/j.ijscr.2020.05.019).

6. Tornambè A, Tornambè G: *Gallstone ileus in an ederly patient. Case report.* Ann Ital Chir, 2017; 6:S2239253X17027232.).

7. Mateş IN, Dinu D, Bârlă R, Cherciu B, Constantinoiu S: *Intestinal obstruction by biliary ileus; Clinical experience and literature review*. Chirurgia (Bucur), 2002; 97(3):263-75.

8. Vasilescu A, Cotea E, Palaghia M, Vintilă D, Târcoveanu FE: *Gallstone ileus: A rare cause of intestinal obstruction. Case report and literature review*. Chirurgia (Bucur), 2013; 108(5):741-44.

9. Nuño-Guzmán CM, Marín-Contreras ME, Figueroa-Sánchez M, Corona JL: *Gallstone ileus, clinical presentation, diagnostic and treatment approach.* World J Gastrointest Surg, 2016; 8(1):65-76.

10. Salazar-Jiménez MI, Alvarado-Durán J, Fermín-Contreras MR, Rivero-Yáñez F, Lupian-Angulo AI, Herrera-González A: *Gallstone ileus, surgical management review*. Chir Cir, 2018; 86(2):182-86.

11. Ploneda-Valencia CF, Sainz-Escárrega VH, Gallo-Morales M, Navarro-Muñiz E, Bautista-López CA, Valenzuela-Pérez JA, López-Lizárraga CR: *Karewsky syndrome: A case report and review of the literature.* Int J Surg Case Rep, 2015; 12:143-5. doi: 10.1016/j.ijscr.2015.05.034

12. Özer N: *Gallstone ileus with evident Forchet sign: Case report.* Int J Surg Case Rep, 2019; 61:153-156. doi: 10.1016/j.ijscr.2019.06.063

13. Lafitte S, Hanafi R, Browet F: *Transrectal endoscopic treatment of gallstone ileus*. J Visc Surg, 2019; 156(3):269-270. doi: 10.1016/j.jviscsurg.2018.10.002.

14. Stagnitti F, Mongardini M, Schillaci F, Dall'Olio D, De Pascalis M, Natalini E: *Fistole bilio-digestive spontanee. Considerazioni cliniche, trattamento chirurgico e complicanze. Spontaneous biliodigestive fistulae. The clinical considerations, surgical treatment and complications*. G Chir, 2000; 21(3):110-17.

15. Ottenello M, Santi F, Fabiano F, Bertirotti S: *L'ileo biliare. Presentazione di 2 casi. Biliary ileus. A report of 2 cases*. Minerva Chir, 1996; 51(1-2):67-9.

16. Cicconi M, Mestichelli A, Sabatini D, Perotti P: *Biliary ileus: Review of the literature and presentation of 7 cases*. Ann Ital Chir, 1989; 60(4):309-14

17. Jakubauskas M, Luksaite R, Sileikis A, Strupas K: *Gallstone Ileus: Management and Clinical Outcomes*. Medicina (Kaunas), 2019; 55(9):598. doi: 10.3390/medicina55090598.

18. Gupta AK, Vazquez OA, Yeguez JF, Brenner B: *Laparoscopic approach for gallstone ileus in geriatric patients*. Cureus, 2020; 12(6):e8642.

19. Hagger R, Sadek S, Singh K: *Recurrent small bowel obstruction after laparoscopic surgery for gallstone ileus*. Surg Endosc, 2003; 17(10): 1679.

20. Allen JW, McCurry T, Rivas H, Cacchione RN: *Totally laparoscopic management of gallstone ileus.* Surg Endosc, 2003; 17(2): 352.

21. Bircan HY, Koc B, Ozcelik U, Kemik O, Demirag A: *Laparoscopic treatment of gallstone ileus*. Clin Med Insights Case Rep, 2014; 7:75-7. doi: 10.4137/CCRep.S16512. PMID: 25187746; PMCID: PMC4133753

22. Assali S, Mourany J, Jones B, Dudas L, Szoka N: *Technical approach to laparoscopic examination of the small bowel in gallstone ileus*. Case Rep Surg, 2020; 2020:8852804. doi: 10.1155/2020/8852804.

23. Joshi M, Nguyen C, Andrade J, Eisdorfer J: *Feasibility of laparoscopic-assisted approach in management of Gallstone Ileus.* Am Surg, 2019; 85(2):e93-e96.

24. Currò G, Iapichino G, Barberio F, Lorenzini C, Melita G, Cucinotta E: *Gallstone ileus: report of a case successfully treated by a laparoscopically-assisted enterolithotomy.* Ann Ital Chir, 2005; 76(2):203-05.

25. Zago M, Bozzo S, Centurelli A, Giovanelli A, Vasino MC: *Laparoscopic and ultrasound assisted management of gallstone ileus after biliointestinal bypass Case report and a review of literature.* Ann Ital Chir, 2016; 87:S2239253X16025676.

26. Muratori R, Cennamo V, Menna M, et al.: *Colonic gallstone ileus treated with radiologically guided extracorporeal shock wave lithotripsy followed by endoscopic extraction*. Endoscop, 2012; 44(2):E88–E89. doi: 10.1055/s-0031-1291641.

27. Sackmann M, Holl J, Haerlin M, Sauerbruch T, Hoermann R, Heinkelein J, Paumgartner G: *Gallstone ileus successfully treated by shock-wave lithotripsy.* Dig Dis Sci, 1991; 36: 1794-795. [CrossRef] [PubMed]

28. Zielinski MD, Ferreira LE, Baron TH: *Successful endoscopic treat-*

ment of colonic gallstone ileus using electrohydraulic lithotripsy. World J Gastroenterol, 2010; 16(12):1533-6. doi: 10.3748/wjg.v16.i12.1533.

29. Maiss J, Hochberger J, Hahn EG, Lederer R, Schneider HT, Muehldorfer S: *Successful laser lithotripsy in Bouveret's syndrome using a new frequency doubled double pulse Nd: YAG laser (FREDDY).* Scand J Gastroenterol, 2004; 39, 791-94.

30. Hendriks S, Verseveld MM, Boevé ER, Roomer R: *Successful endoscopic treatment of a large impacted gallstone in the duodenum using laser lithotripsy, Bouveret's syndrome: A case report*. World J Gastroenterol, 2020; 26(19):2458-463. doi: 10.3748/wjg.v26.i19.2458.

31. Dumonceau JM, Devière J: *Novel treatment options for Bouveret's syndrome: a comprehensive review of 61 cases of successful endoscopic treatment*. Expert Rev Gastroenterol Hepato, 2016; 10(11):1245-255. doi: 10.1080/17474124.2016.1241142

32. Balzarini M, Broglia L, Comi G, Calcara C: *Large bowel obstruction due to a big gallstone successfully treated with endoscopic mechanical lithotripsy*. Case Rep Gastrointest Med, 2015; 2015:798746. doi: 10.1155/2015/798746.

33. Mishin I, Ghidirim G, Zastavnitsky G: *Non-operative treatment for gallstone ileus. A case report*. Pol Przegl Chir, 2011; 83(4):2232-36.