

## GALLSTONE ILEUS – STILL A PROBLEM

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**Abstract.** *Gallstone ileus remains a rare but important cause of bowel obstruction. It occurs in elderly patients in up to 25% of the cases and represents a serious geriatric emergency. It is usually associated with a cholecystoenteric fistula through which a gallstone has passed into the gastrointestinal tract and this represents the most frequent mechanism by which it occurs.*

*The occurrence of subsequent pneumobilia provides a strong clue to the diagnosis of gallstone ileus, but it is not found in all patients.*

*Helical-single detector and MDCT may improve the diagnosis of gallstone ileus providing informations regarding the number, size and location of ectopic stones and the site of intestinal obstruction or visualization of a biliary-enteric fistula.*

*The management of gallstone ileus remains controversial. Open surgery has been the mainstay of treatment, but laparoscopic surgery has recently been used. Whether it is preferable to perform the more complex one stage operation, or the simpler enterolithotomy, continues to be actively debated.*

*Gallstone ileus results in considerable morbidity and mortality. This is partly due to the elderly patient population having multiple medical comorbidities and delayed presentation and diagnosis.*

**Keywords:** gallstones; intestinal obstruction; pneumobilia; emergency surgery

**Rezumat.** *Ileusul biliar este o cauza rară de obstrucție intestinală. Apare în 25 % din cazurile de ocluzie intestinală la pacienții vârstnici reprezentând o urgență geriatrică gravă. Fistula colecisto-enterală reprezintă mecanismul de producere obișnuit. Cheia diagnosticului este evidențierea pneumobiliei la examinările radiologice. Examinarea CT abdominală aduce informații importante referitoare la numărul, dimensiunile și localizarea calculilor biliari ectopici, sediul ocluziei enterale și evidențiază fistula bilio-digestivă permițând astfel diagnosticul pozitiv precoce. Tratamentul ileusului biliar prezintă controverse legate de tipul intervenției chirurgicale efectuate: enterolitomie sau procedură "one stage"; actual s-a utilizat și chirurgia laparoscopică. Mortalitatea și morbiditatea crescute sunt explicate prin vârsta avansată a pacienților, patologia asociată, prezentării tardive la medic și diagnosticului întârziat.*

**Cuvinte-cheie:** litiază veziculară; ocluzie intestinală; pneumobilie; chirurgie de urgență

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*“It is less dangerous to leap from the Clifton Suspension Bridge (250 to 275 feet above the Avon River) than to suffer from acute intestinal obstruction and decline operation”.*

**Frederick Treves, 1899**

Gallstone ileus represents a rare (0,3 - 0,5 %) (1) but severe complication of cholelithiasis. It is considered that its incidence has remained constant, accounting for 1-3% of all small bowel obstructions (2, 3, 4, 5, 6) and for almost 25% of all unstrangulated hernias in patients over 65 years of age (7, 8).

This complication has significant morbidity and mortality rates due to delayed diagnosis.

### **1. History**

The first case of gallstone ileus was reported by the danish anatomist Thomas Bartholin in 1654, during an autopsy (9, 10). He is the first to use the term of gallstone ileus in direct relation to the cause.

Later, in 1841, Bonnet describes the first case of duodenal obstruction (1) due to a gallstone stuck within the first portion of the duodenum. The first preop diagnosis of gallstone ileus was made in 1896 by Leon August Bouveret, where a calculus was lodged in the gastric antrum producing a syndrome bearing the name of its discoverer (1, 11, 12).

In 1932 Henry Hubert Turner described the first case of colonic gallstone ileus (where the calculus was lodged in the transverse colon) (1, 12).

Over 300 years later we now know the possible types of this particular form of intestinal obstruction that requires a biliary-intestinal fistula for it to occur. Later research has revealed further pathogenic and therapeutic elements, which will be summarized in this review.

In time the incidence rate of gallstone ileus has increased so much so that Bohan (14, 15) reported in 1993 a total of 750 cases (with 15 cases of recurrent gallstone ileus reported in Rusia), while Reisner (8) reported 1001 cases of gallstone ileus (with 5% of cases being recurrent ileus cases).

Later, Frattaroli reports a total of 240 cases of Bouveret syndrome in a review published in 1997 (16).

Our study includes 92 cases of gallstone ileus reported or published until 2011 at the Clinical Emergency Hospital, which accounts or 51.11% of the national case records. 36 patients were operated on between 1991 and 2011 (20, 21, 22, 23).

### **2. The surgery of gallstone ileus in Romania**

There were 180 cases of gallstone ileus reported in Romania between 1897 and 2011, but, undoubtdedly, the real number is higher.

The first case of gallstone ileus to be operated on was reported by Valentin St. John from Targu-Mures and it was published in 1929 in *Chirurgia* magazine. The case detailed a Bouveret syndrome in a 70 year-old female patient that has died postoperatively (17).

In 1932, Professor of Surgery Amza Jianu successfully operates a case of gallstone ileus in a 66 year-old female patient (18). Later on, in 1935, Iacobovici was the first in the country to successfully operate a Bouveret syndrome in a 64 year old male patient (19).

### 3. The age

Although it was initially believed that gallstone ileus is a condition affecting mostly the elderly, this has been proven a myth.

The youngest patient ever reported to suffer from gallstone ileus was 13 years old (24) and the oldest one was 91 years old (japanese literature) (4). Bohan reports a case involving a 12 year old boy with gallstone ileus with the calculus situated in the colon and another 10 year old german child suffering from the same condition (15).

This disease is characterized by a higher incidence in patients over an average of 65 years, a higher incidence in female patients-(male/female ratio=1/5:1/10, probably secondary to an increased incidence of cholelithiasis in female patients) and preop dianostic rate of < 50% (4, 7, 8, 24, 25).

### 4. The incidence

The incidence of gallstone ileus has remained rather constant over the last 45 years: 30-35 cases per 1,000,000 admissions (Kurtz cit.Moberg- 26), an average of 0.9/100,000/year (26). Gallstone ileus accounts for 2-3% of causes of intestinal obstruction identified at exploratory laparotomy (2, Kasahara cit. 3). The incidence of gallstone ileus in patients over 65 years of age is approximately 25% of all unstrangulated obstructions (7). The colonic ileus due to a calculus has a lower incidence, accounting for 2-8% of all gallstone ileus cases (27). The reported incidence of gallstone ileus in rusian patients with intetsinal obstruction ranges between 1.83 and 9.32% (15.28). Females and elderly patients are also more frequently affected. Furthermore, the incidence of this condition increases with age.

### 5. Pathogenesis

In order for the disease to occur it is imperative that two elements combine:

1. A large gallbladder calculus (a diameter over 2.5 cm) within the gallbladder;
2. Cholecysto-intestinal fistula.

In addition to these factors an intestinal stenosis may also contribute(either inflammatory or postoperative).

The most frequent pathogenic mechanism is represented by the migration of a calculus from the gallbladder into the intestinal lumen through a fistula, usually into the duodenum (in 68% of cases, 96.5% of japanese patients, 4), but it can also

migrate into the jejunum, colon (5-25%, 29, 30), cholecysto-duodeno-colonic (2.5%), cholecysto-gastric (Clavien 31, Rodriguez Sanjuan 32, Glenn cit. 33), choledocho-duodenal, duodenum-left hepatic duct (1, 34).

Usually the gallstone ileus is preceded by an episode of acute cholecystitis followed by a chronic inflammation and adhesions between the intestine and the gallbladder (usually involving the fundus). In addition to these elements, the ischemic effect due to the pressure caused by the calculus facilitate the establishment of a cholecysto-digestive fistula (decreased lymphatic, arterial and venous blood flows)(1); sometimes an obstruction of the cystic duct is also present (5). The intestinal wall erosion is smoothed by the presence of crystalized billiary salts. In most cases, the gallbladder turns sclero-atrophic and rendered non-functional. Most frequently, the gallbladder fundus adheres to the duodenum, colon, stomach (in that order) and very rarely to the kidney, mesentery or to the liver itself.

The size of the calculus is also important in triggering the intestinal obstruction, most authors agreeing that a diameter > 2.5 cm ensures complete intestinal occlusion (it is important that no other lumen stenosis is present caused by spasm, adhesions, Crohn's disease, pre-existent anastomosis).

In 1975, after thoroughly analyzing 1000 cases of gallstone ileus described in literature, Day and Marks (35) established that the average diameter is 45 mm (ranging between 20 and 100 mm) and the weight of approximately 23.5 g (ranging between 4 and 68 g).

According to Suteu and Bucur (21), the main cause of gallstone ileus is represented by a dyssynergy between the spasm of the circular fibers and the hyperperistalsis of the longitudinal ones; the hyperperistalsis upstream aggravates intestinal lesions near the obstacle and at the occlusion site the parietal edema could potentially lead to wall necrosis.

The calculus usually occludes the terminal ileum (65%) and the ileo-cecal valve (which is the most narrow segment of the small bowel and the peristalsis is reduced) (8, 28, 36). The potentially active bile ingredients may interact with the intestinal cells and could induce complete occlusion and mucosal injury (Chipman cit.9).

The stone impaction is due not so much to mechanical factors but to bile-irritating mechanisms triggering the intramural paracrine signaling; at the blockage site a rapidly evolving edema ensues, which usually progresses to wall necrosis.

The sensitivity to billiary salts of the distal ileum, which is constantly part of the bile entero-hepatic circle, is the main factor contributing to gallstone ileus, because the distal ileum traps most migrating foreign bodies, particularly those rich in bile salt (17).

Duodenal obstruction is rare, occurring in 3-10% of cases (25); even more rarely are the cases of a calculus lodging in Meckel's diverticulum (37, 38) or the appendix (Mehrotra cit. 12).

Beltran (39) suggested another possible mechanism represented by an association between a Mirizzi syndrome and cholecysto-enteral fistula, other authors

having described cases of gallstone ileus in patients presenting type IV Mirizzi syndrome and cholecysto-colonic fistula.

According to Reisner (18), the colonic blockage usually occurs in 4% of cases, most frequently within the sigmoid colon (due to secondary stenosis following recurrent diverticulitis).

The colonic ileus most frequently occurs following a stone migrating through cholecysto-colonic fistula, as well as through a cholecysto-duodenal fistula (Moller 1913, Harris, McNamara si Dardinski 1947, Buetow, Glaubitz si Crampton 1963-cit. 13) or a choledoco-duodenal fistula (Shore, Jacob si Cannon 1953). Holm-Nielsen and Linnet-Jepson consider that the ileus is due to progressive increase in initial stone size, while Haffner, Semb and Aakhus consider that the calculus size increases due to fecal accumulation around the stone (13). The most frequent phenomenon is represented by the impaction of a large calculus in a spastic colon, while impaction secondary to lumen stenosis (recurrent diverticular disease, cancers) is less common.

In time, the pathogenesis of gallstone ileus has had some changes following reports of cases of small bowel obstruction caused by a gallstone but without the operative identification of a cholecysto-enteric fistula (10, 40).

Hence, the following possibilities have been described:

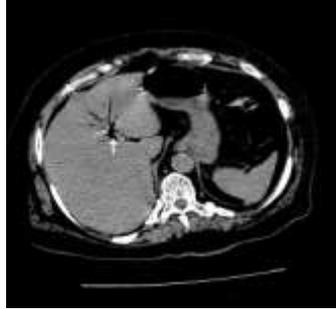
- Yoshida and co. has described a case of gallstone ileus after the calculus passed through the Vater papilla and underwent secondary enlargement within the intestine, which had a previous stenosis (41).

- The post-cholecystectomy gallstone ileus has the following varieties:

- Lassandro (42), Lindsey and Warner (cit. 43) have described a case of gallstone ileus after cholecystectomy, the calculus having migrated along the common bile duct (after sphincterotomy) or from a pulsion duodenal/jejuno-ileal diverticulum. Saedon (44) reports a case of gallstone ileus 24 years after cholecystectomy in a patient with jejuno-ileal diverticular disease.
- Draganic (43) and Dittrich (45) report two cases of intestinal obstruction when a “lost” calculus after a difficult laparoscopic cholecystectomy migrated through the jejunal wall. Wills (46) described a case of partial intestinal obstruction due to gallstones, that was spontaneously resolved, but Dragnic and Dittrich were the first to publish articles referring to gallstone ileus. Gorecki (47) reports a similar case (Surgical Rounds 2001). Habib (48) reports a case of gallstone ileus occurring 8 years after laparoscopic cholecystectomy during which a calculus was “lost” in the abdominal cavity; the stone migrated through the greater omentum, eroded the apex of a Meckel diverticulum, lodging at its base, eventually migrating into the intestinal lumen, occluding it. The calculus was mobilized and removed through the actual diverticulum, thanx to its loose base. At the Clinical Emergency Hospital in Bucharest we had a case of incomplete intestinal obstruction due to a calculus that has eroded the colonic wall creating a persistent colonic-cutaneous fistula (**figures 1, 2 ,3**). It may actually be the first case of this kind to be reported in the national medical literature (Ivanov 49).

**Figure no. 1.**

*Plain abdominal X-ray: ectopic gallstone (within the bowel-3), dilated small-bowel loops, air-fluid levels of the small-bowel (2), pneumobilia (Rigler's triad-1).*

**Figure no. 2.**

*Axial MDCT image showing air in the biliary tree (pneumobilia-arrow).*

**Figure no. 3.**

*Multidetector computed tomography scan showing distended bowel loops (→) and an ectopic radiopaque gallstone in the intestinal lumen (→).*

- Gallstone ileus and Crohn's disease

Patients with Crohn's disease often develop cholelithiasis due to alterations in cholesterol solubility in bile salts, facilitating its precipitation (due to changes in entero-hepatic blood flow), to increased bile bilirubin (which may determine "in situ" growth of pigmentation calculi) and to intestinal motility alterations (50, 51, 52).

The average sizes of the typical obstructing calculus in patients with Crohn's disease are inferior to the "usual" lodging-calculi: 2,5 cm (1.5 - 3 cm) versus 4,5 cm (2-9 cm), a fact explainable by the typical fibrous intestinal stenosis (3).

## 6. Clinical forms

There are 4 different clinical presentations of gallstone ileus: Bouveret syndrome, colonic gallstone ileus, the classic jejuno-ileal obstruction (which is considered the actual gallstone ileus) and recurrent gallstone ileus.

Bouveret syndrome accounts for 3-6% of all gallstone ileus cases (15, 16, 53), affecting mostly women and patients between 65-75 years of age (54).

Recurrent gallstone ileus has an incidence of 4,7-5 % (5, 8, 56) and is defined as a mechanical intestinal obstruction either secondary to a previous endoluminal gallstone, which is not occlusive at the time of the initial surgical intervention/treatment, or is secondary to another gallstone migrating through a surgically-"missed" cholecysto-intestinal fistula (Levin cit. 42,55). According to Kurguzov (57) this is due to an incomplete check for the small bowel vacuity during the initial surgical intervention (potentially occlusive remaining gallstones). Subbotin (58) reports an incidence of recurrent gallstone ileus of up to 7-20%, which is a much higher than other reports from anglo-american authors. Recurrent gallstone ileus is associated with a death rate of up to 20% (56).

Cylindrical or multifaceted calculi are predictive for recurrent gallstone ileus. According to Buetow (cit. 55) most recurrent gallstone ileus cases occur within 30 days after the initial operation, with the ileum being the most frequent site of obstruction. This fact has been confirmed by our own cases at the Clinical Emergency Hospital in Bucharest.

### *Clinical types*

- There are usually 3 clinical types of this disease:
  - Acute, corresponding to the classic gallstone ileus;
  - Subacute, with subocclusive manifestations;
  - Chronic (Karewsky syndrome), characterized by recurrent painful episodes secondary to the endoluminal progression of the calculi (Rodriguez Hermosa 59).
- Hildebrandt (60) describes 3 clinical forms: occlusive (50%), renitent (30%) and peritonitic (20%).
- The clinical and physiopathological types of gallstone ileus according to the obstruction site:
  - Supra or juxtavaterian: hyperacide emesis, flat abdomen ± some pancreatic response (due to papillary compression); the blood work reveals metabolic alkalosis.
  - Subvaterian duodenal lodging: alkaline emesis (contains bile), flat abdomen ± metabolic acidosis.
  - Distal to Treitz angle in clavation: mixed emesis, slightly distended abdomen, intermittent colicky pain.

## **7. Diagnosis**

Due to its unspecific symptoms the diagnosis of gallstone ileus is difficult, and were it diagnosed early it would reduce the mortality. According to russian authors, a correct preop diagnosis is made in 7-22% of cases (61, 62, 63, 64, 65, 66), most frequently being established during surgery(67, 68, 69).

There are authors reporting preop diagnostic rates in 41-75% of cases (5, 7, 8, 70, 71, 72). Patients with gallstone ileus usually have other comorbidities, including obesity, diabetes mellitus, cardio-vascular conditions, old age, electrolyte and other humoral imbalances.

According to Cooperman, there is a mean period of 7 days from the onset of symptoms to actual hospital admission (independent prognostic factor) and of 3.7 days to the surgical intervention (25). As such, there is a 7-10 day delay of the operation from the initial insult. We conducted such a study at the Clinical Emergency Hospital in Bucharest, measuring the time interval between symptom onset-hospital admission, which was an average of 4.46 days, concurring with other reported statistics.

50% of patients had a history relevant for chronic gallbladder conditions. In elderly patients, who repeatedly refused the operation, the time span can extend up to 20-40 years of biliary problems (73).

The symptoms are usually intermittent, creating the so-called tumbling phenomenon, suggesting high intestinal obstruction (3): recurrent, downward shifting, colicky, abdominal pain, until the calculus is lodged („*the pain shifts alongside the stone*” - Chauffard). The main symptom is the abdominal pain, associated with nausea and vomiting and sometimes hematemesis following duodenal mucosal erosions.

Fecal vomiting occurs in later stages and is considered to be „imminent-death sign rather than an obstruction sign” (Handley cit. 27).

The clinical picture of gallstone ileus is rather variable in direct relation to:

1. The bilio-digestive fistula;
2. The severity of the intestinal occlusion;
3. The time interval between the onset of the fistula and the onset of the ileus itself (Vikker 74).

There are a few signs and symptoms suggesting an internal biliary fistula:

1. The decrease in size or even the disappearance of a palpable mass in the right upper quadrant;
2. Improvement of abdominal pain, fever and jaundice;
3. Onset of symptoms suggesting gallstone ileus in patients >60 years of age with known cholelithiasis;
4. The presence of calculi larger than 1 cm in diameter in the feces, or rarely in the vomit (75).

Usually, the positive diagnosis is based on the clinical exam (high intestinal obstruction), plain abdominal x-ray and CT scan of the abdomen and pelvis.

## 8. Medical investigations

- **The plain abdominal x-ray** reveals:
  - Rigler’s triad (1941): aerobilia (Gotta-Mentschler sign), an ectopic opaque calculus, distended bowel loops (>2.5 cm) (Rigler cit. 22) - **Figure no. 1.**

According to most authors Rigler’s triad is present in 17-87% of patients (5, 76), 2 out of 3 signs being sufficient for a positive diagnosis (only 10% of gallstones are calcified and visible on x-rays).

If a second x-ray is taken and there is gallstone shifting compared to the previous examination then Rigler’s triad becomes Rigler’s tetrade (Rigler cit.7).

It is important to bear in mind that aerobilia can occur secondary to a bilio-digestive anastomosis (usually choledochoduodenal anastomosis), previous endoscopic sphincterotomy or due to an incompetent Oddi sphincter.

- Balthazar-Schechter sign (77) - dilated air and fluid-filled duodenal cap associated with a second fluid level adjacent and lateral to it.

- ***Abdominal CAT scan***

It is the most useful imaging examination for the positive diagnosis of gallstone ileus because it provides diagnostic clues indicative for the obstruction type, its location, associated inflammatory changes of the gallbladder and other possible abdominal conditions.

The CT scan reveals (42, 78, 79, 80):

- Aerobilia (**figure no. 2**);
- Obstruction-like, distended bowel loops;
- Ectopic, endoluminal calculus/calculi (**figure no. 3**). These elements create a tomographic Rigler's triad.
- The size of the calculus judging by the differences in luminal diameters before and after the blockage.
- Gallbladder wall changes (particularly chronic conditions, the presence of a fluid-air level, irregular gallbladder wall with fluid accumulation);
- Cholecysto-digestive fistula +/- local inflammatory response.

By using dynamic abdominal CT examinations Loren (81) was able to prove the progression from a chronic gallbladder inflammation to fistula formation and secondary ileus.

In a prospective study, Yu and co. (82) states that contrast abdominal CT scan for gallstone ileus has a sensitivity of 93%, a specificity of 100% and an accuracy of 99%, using the diagnostic criteria: small bowel obstruction, ectopic gallstone, parietal and endoluminal changes of the gallbladder.

According to Lassandro and Pickhardt (42,83), employing MDCT (MultiDetector Computed Tomography) as a diagnostic tool enables the identification of endoluminal calculi, assess their size and number, allowing an early diagnosis of gallstone ileus, long before the onset of typical clinical signs. Furthermore, the identification of the bilio-digestive fistula allows the surgeon to choose the right course of action: cholecystectomy (in large fistulas with residual gallstones) or medical treatment.

We used abdominal CT scans as a routine diagnostic tool at the Clinical Emergency Hospital in Bucharest and it enabled us to positively diagnose gallstone ileus in 87.5% of cases, leading to an overall decrease in morbidity and mortality rates, as well as hospitalization expenses.

- ***The abdominal x-ray with contrast***

It is no longer used as a routine diagnostic tool, its efficiency being outrun by that of the contrast CT scan. However, it remains useful when CT scan is not available.

In order to be performed, it requires the administration of a water-soluble contrast via the naso-gastric tube (Gastrografin®, Urografin®). Hildebrandt (60) recommends it as a second-line diagnostic method. At the lodging site there is a characteristic image „snake head-like”, with a clear halo, produced by a transparent or dark calculus (Svanholm cit.84), known as the Forchet sign. The examination may also reveal the presence of a bilio-digestive fistula (**figure no. 4**).

In such circumstances, barium administration may aggravate symptoms of ileus as a result of barium-induced impaction, particularly in a paralytic bowel or in the presence of a prestenotic colon segment.

This approach should not be used if there is a possibility of impaired intestinal viability or gastrointestinal perforation, because extravasation of barium into the peritoneal cavity can precipitate a severe and potentially fatal inflammatory response.

- **Abdominal ultrasound**

Could reveal residual cholelithiasis, the presence of a bilio-digestive fistula, possibly the lodged calculus within the bowel lumen, gastric dilatation in Bouveret syndrome (85, 86), aerobilia (**figure no. 5**). It also describes the local anatomy which has surgical implications.



**Figure no.4.**  
*An upper GI contrast examination showing cholecysto-enteric fistula.*



**Figure no.5.**  
*Abdominal ultrasonography- pneumobilia (arrow).*

After performing abdominal US in 40 patients with gallstone ileus, Dibirov (87) reports the following results: positive calculus identification in 16 patients (40%), aerobilia in 26 patients (65%), gastric stasis in 8 patients (20%) with Bouveret syndrome, intestinal air in 30 patients (75%), intestinal hyperperistalsis in 16 patients (40%), free peritoneal fluid in 20 cases (50%).

In 22 patients (55%) that underwent series of abdominal ultrasound examinations he was able to diagnose the cholecysto-gastric fistula, with evidence of calculus migration, positively diagnosing the gallstone ileus.

In all 40 patients the ultrasound yielded both direct and indirect signs of intestinal obstruction:

- 12 patients had distended bowel loops, hyperperistalsis and heterogenous intestinal content;
- 14 patients had air in the gallbladder, 6 had aerobilia within the common bile duct and hepatic bile ducts, 13 had thick gallbladder walls (7-10 mm) and gallstones;

- in 20 patients (50%), the US revealed a structure with stable characteristics when shifting the transducer, which was indicative for the diagnosis and the location of the obstacle (the duodenum-4 cases, the small bowel-2 cases, the ileum-1 case).

Based on these results we can state that dynamic monitoring by abdominal ultrasound is a useful screening and diagnostic tool, with results yielding implications for further management. Combining the abdominal US with plain abdominal x-ray increases the diagnostic sensitivity to 74% (12, Ripolles cit.24, 76).

The inflammation may seal the proximal segment of the cholecysto-duodenal fistula, all that remains is a small diverticulum containing a small, residual calculus (sentinel gem), suggestive for the diagnosis (88).

- ***Upper GI endoscopy***

Its primary indication resides in diagnosing Bouveret syndrome, the first such case having been reported by Grove in 1976 (89). According to Capell the actual visualization of the obstructing calculus is possible in 69% of cases and that of the cholecysto-gastric or cholecysto-duodenal fistula may be possible in 31% of cases. In the remaining cases the visual identification is not possible due to external duodenal compression, edema and local inflammation.

Arioli (91) describes another form of Bouveret syndrome characterized by partial obstruction and intermittent symptoms, caused by a large calculus (over 4 cm in diameter), which required a “one-stage” surgical resolution.

Upper GI endoscopy may reveal the duodenal ostium of the cholecysto-duodenal fistula, which corroborated with the clinical manifestations of high intestinal obstruction, allow a preop diagnosis of gallstone ileus. Sometimes, the endoscopy may show a small diverticulum containing a sentinel gem, which could also suggest the diagnosis (88).

In patients with symptoms of upper intestinal obstruction, an ulcer-like lesion diagnosed endoscopically can actually be the duodenal ostium of a bilio-digestive fistula. We therefore suggest that this finding be considered an indirect sign for diagnosing gallstone ileus (Beuran, Ivanov, Venter).

- ***Colonoscopy***

It shows the the obstacle and its location (30) and sometimes the colecysto-colonic fistula.

- ***MRCP-magnetic resonance cholangio-pancreatography***

It failed to prove its diagnostic value; it only shows pneumobilia. According to Pickhardt (92), however, it allows the accurate assessment of the calculus size.

- ***Exploratory laparoscopy***

It is rarely used as a diagnostic tool (Agresta cit.41) but more as a treatment method, particularly in medical centers where elective laparoscopic operations are routinely performed.

## 9. Complications

- juxtacalculus perforation (93);
- Proximal perforation; it is rare, having been described in less than 10 cases (94);
- Wernicke encephalopathy secondary to decreased thiamine absorption (95);
- Complications due to the cholecysto-colonic fistula (14%) (5);
- Traumatic fistula rupture (96).

## 10. Treatment

The purpose of the treatment is the obstacle removal. The surgery should be preceded by adequate hydration, electrolyte correction and treatment of any other medical condition. According to Clavel (cit. 22) the systemic impact of gallstone ileus is more important than the surgical impact because it produces severe biochemical imbalances and the therapeutic approach is based not so much on the surgical technique but on the surgical strategy, choosing the right moment to intervene is paramount.

There are several therapeutic approaches: surgical (open/laparoscopic), endoscopic and conservative.

### *The surgical treatment*

The surgical approach of gallstone ileus has varied between enterolithotomy and “one stage” operations, each method having its pros and cons, based on the patient’s general status. The major surgical risks have made possible for other, less invasive methods to evolve, such as interventional endoscopy, extracorporeal shock-wave lithotripsy (ESWL), ultrasound-guided ESWL (Clavien cit.1,42; Meyenberger cit.5,24,56) and laparoscopic interventions, which is still debatable.

- Classic surgical procedures include:

❖ **Enterolithotomy** - during surgery, visual and manual exploration of distended bowel loops usually lead the surgeon to the obstruction site (**figure no.6**).

❖ Usually, the calculus should be mobilized either distally (rarely possible) or proximally, in such a way that the enterotomy is placed in an ulceration-free area or with minimal circulatory damage. In 1947 Victor Dimitriu said: “ what catches your attention is the immobility of the calculus; the upstream intestine is distended, the bowel wall is infiltrated at the obstruction site in such a way that any attempt to mobilize the calculus upstream is futile” (97). His statements remain true even today.

The enterotomy shall be performed proximally, at approximately 15-20 cm uphill the obstacle (longitudinal wise, on the antimesenteric margin), after mobilization of the calculus, followed by its extraction (**figures no.6, 7**) and single-layer enterorrhaphy.



**Figure no.6**  
*Gallstone ileus - intraoperative imagine.*



**Figure no. 7**  
*Enterolithotomy.*

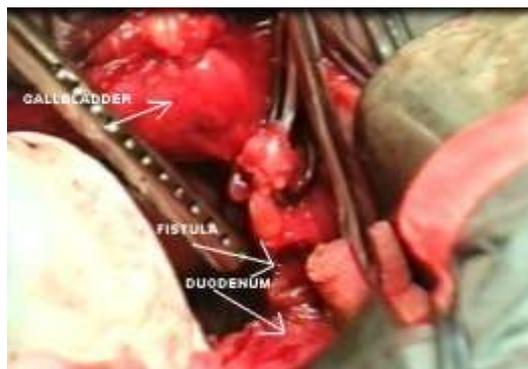
The entire intestinal tract shall be explored for other possible, residual calculi that could trigger a recurrent gallstone ileus. In the altered elderly patients it is not indicated to explore the cholecysto-duodenal area (2).

❖ **Segmental enterectomy** is indicated only when intestinal perforation is present or severe ischemic lesions. This method has several advantages, which are paramount in acute care surgery: rapid resolution in severe cases; simple technique.

The main disadvantages include:

- ⇒ Risk of recurrent gallstone ileus caused by a “silent” residual calculus (“silent second stone”).
- ⇒ Persistence of biliary symptoms (acute cholecystitis, recurrent cholangitis) or secondary to the bilio-digestive fistula;
- ⇒ Increased incidence of gallbladder carcinoma with persistent bilio-ental fistulas (Berliner si Burson cit.1,8,98);
- ⇒ Malabsorbtion, which is more frequent in cholecysto-colonic fistulas.

One stage procedure implies proximal enterolithotomy, cholecystectomy and fistula resolution (**figure no. 8**). It ensures definitive treatment, avoiding reinter-ventions. Its main disadvantages include high morbidity and mortality rates (8, 99) secondary to a lengthy and complex operation. Its indications include gallbladder gangrene, residual calculi found during laparotomy (100), hemobilia (57, 65), low-risk patients (5), cholecysto-colonic fistula.



**Figure no.8.**  
*Bilio-enteric fistula - intraoperative imagine.*

Two-step procedures involve an initial enterolithotomy followed 4-6 weeks later by cholecystectomy and fistula resolution. It is indicated in debilitated, elderly patients, with severe electrolyte imbalances, with other comorbidities, residual gallstones and inflammation of the fistula.

Jarling (101) recommends fistula resolution to take place 4-6 months after the intestinal obstruction has been resolved.

Appealing as it may be to us, it is highly unlikely that an old patient would consent to another surgery, especially when there is no acute issue.

Zaliekas (76) recommends this procedure for young patients, with risks for later biliary complications or with recurrent biliary pathology.

- Specific surgical approaches:

According to Petroianu (102) high-risk patients undergo enterolithotomy, followed by cholecystectomy if residual gallstones are present, gallstone removal and cholecystostomy, sparing the fistula.

*Bouveret syndrome surgery*

When dealing with Bouveret syndrome patients, the sole purpose of the treatment is the obstacle removal.

*Classic surgical techniques:*

❖ Approaching the upper intestinal obstruction by gastro or duodenolithotomy.

❖ One stage procedures: gastrotomy/ duodenotomy, calculus removal, cholecystectomy and fistula resolution. According to most authors, this procedure has a mortality rate of 20-30% (8, 32, 103, 104, 105).

❖ Two-stage procedures: gastrotomy/ duodenotomy, calculus removal, gastrorrhaphy/duodenorrhaphy; 4-6 months later cholecystectomy is performed with fistula resolution. This procedure is indicated when postop complications are encountered, such as cholangitis, stenosing pilorus/duodenal ulcers near the fistula, jaundice, hemobilia, traumatic fistula rupture. The 4-6 month delay is mandatory in order to correct the associated medical conditions in order to minimize the operative risk (15).

The indications for surgical approach in Bouveret syndrome include:

- Esophageal stenosis (precluding the interventional endoscopy)
- Lodged calculus within the fistula, exerting extrinsic duodenal compression;
- Calculus > 4 cm;
- GI bleeds;
- Endoscopic calculus removal failure;
- Persistent obstruction after endoscopy.

When these indications are not valid and when a permeable cystic duct is present, the fistula may resolve spontaneously, without surgery (106).

### ***The treatment of colonic gallstone ileus***

The most frequent location is represented by the impaction of a large calculus in a spastic colon, usually in the sigmoid colon because of frequent stenosing lesions (inflammatory or neoplastic).

Recommended surgical procedures include:

- Cololithotomy;
- Proximal colostomy and calculus removal;
- One stage procedures are indicated because of frequently associated, ascending cholangitis.

### ***Laparoscopic procedures***

They are not the therapeutic “golden standard” (76) due to technical difficulties caused by distended intestines, the almost impossible identification of the gallstone, long duration of the intervention and the need to have trained surgeons in acute care and laparoscopic surgery (24, 107).

Until 2001 there were only 3 studies discussing the role of laparoscopy in gallstone ileus: Montgomery (108), Franklin (109), Sarli (110).

The enterolithotomy may be performed entirely laparoscopical (33) or laparoscopically-assisted (1, 34, 108), when the intestinal segment is externalized through a small incision after calculus identification; the gallstone is mobilized and an enterolithotomy is then performed.

Moberg and Montgomery (26) conducted a retrospective study that included 32 patients with gallstone ileus. Between 1992 and 2004, these patients underwent both laparoscopic and open enterolithotomy, with 19 patients being managed laparoscopically and only 2 conversions. The authors state that laparoscopically-assisted enterolithotomy can be recommended as a diagnostic and therapeutic tool.

Sica (111) and Malvaux (112) publish each a case of Bouveret syndrome managed laparoscopically. Sica’s case was a one stage procedure with an external biliary drainage. Malvaux’s case was resolved using laparoscopically-assisted endoluminal endoscopy.

Later, Krigher (113) reports a case of recurrent gallstone ileus in postop day 5, which was resolved through laparoscopically-assisted enterolithotomy, with positive outcome.

Laparoscopic one-stage procedure was also employed by Franklin Jr. in 1994 (cit.114).

Today there is no unanimous consensus on enterolithotomy as a one-stage procedure; most authors consider that enterolithotomy is the adequate surgical approach (2, 4, 24, 115, 116). Another large gallstone in the gallbladder, identified at ultrasound would elicit a “one-stage” procedure in order to avoid recurrent gallstone ileus. Our own experience at the *Clinical Emergency Hospital* supports the superiority of “one stage surgery” (in terms of morbidity and mortality rates) compared to enterolithotomy, although it is not always available to us (117).

### ***Interventional endoscopy***

It is the treatment of choice in high-risk patients, particularly those with Bouveret syndrome (118).

However, the success of this procedure is strictly related to the possibility of gallstone fragmentation. The lithotripsy may be mechanical (unfortunately not always possible for large calculi) - endoscopic mechanical lithotripsy (119, 120), electrohydraulic (121), combined (mechanical and electrohydraulic) (122), extracorporeal shock wave lithotripsy (ESWL) (123), laserlithotripsy (124, 125) (Holmium:YAG, Rhoadmine 6G, FREDDY) (126), ESWL and argon plasma coagulation (127).

The absolute contraindication for lithotripsy is a calculus diameter > 4cm.

Lubbers (120) and Hauke (128) reported cases of small bowel gallstone ileus managed endoscopically (single/double balloon endoscope followed by fragmentation of the calculus with Dormia probe and its removal).

In high-risk patients, Shenoy (129) recommends a colonoscopy as a mean to mobilize a lodged calculus to the ileo-cecal valve, with temporary symptom alleviation, during which time the patients may be stabilized for surgery.

Most authors that have published articles addressing the endoscopic management of gallstone ileus also rise the issue of distal ileus due to gallstone fragments (103, 126, 130, 131).

When the obstructing calculus is located within the colon, the endoscopic approach is possible and elegant (Nakamoto 132). Pracki (30) reports a case where laser-guided colonic lithotripsy was combined with tissue marking and Zielinski (133) also associates intracorporeal, electrohydraulic, endoscopic lithotripsy (IEHL).

It is important to bear in mind the fact that interventional endoscopy is a „second line” therapeutic option, reserved only for high-risk patients.

### ***Conservative management***

Sometimes „gastric lavage and intestinal tube placement with continuous drainage may lead to calculi being spontaneously removed” (97). Conservative management is indicated when the radiologically measured calculus is < 2 cm. 14.2% Japanese patients were successfully managed this way (4).

1.3% of patients eliminate the gallstones naturally (8, 132). Bohan (15) reported in a study including 750 patients that 23 patients (5.5%) eliminated the calculi through emesis or defecation (most frequent way), in 4 situations manual removal from the rectum being necessary.

For a correct diagnosis as well as for follow-up in all patients non-surgically managed, CT and MDCT scans are extremely useful, allowing the accurate assessment of number, size, location of ectopic calculi. An early diagnosis dictates the appropriate therapy and decreases morbidity and mortality rates.

## 11. Morbidity and mortality

„The seriousness of gallstone ileus is obvious. I don't recall having cured a single case. It is baffling how simple the operation is and how disastrous the outcome is” (Delbet).

Its low incidence, elderly patients, delayed diagnosis are all factors contributing to the high morbidity and mortality rates of a benign disease. The postoperative mortality rate ranges between 0 and 26% (1, 4, 5, 8, 12, 15, 24, 26, 29, 34).

Reisner published a metanalysis of 1001 reported patients with gallstone ileus, diagnosed between 1953 and 1993, establishing an overall mortality rate of 14.28% (8) (11.7%-enterolithotomy, 16.9% - one stage procedure). In his 750-patient study (1893-1993), Bohan (14, 15) reports a mortality rate of 66-85% (the start of the XXth century), subsequently decreasing to 26% towards the end of the XXth century. The study includes patients with gallstone ileus from 16 different clinics from the ex-USSR (10-42 patients per clinic) and the mortality varies between 0 and 54.6 %, with an overall mortality of 26.2%.

The most frequent complication is represented by wound infection - 32% (8).

The morbidity and mortality rates are influenced by the diagnostic delay due to late hospital presentation (on average 4.85 days), age >60 years, associated chronic conditions, a severe APACHE II score ( on average 8.71 points) (1).

## REFERENCES

- [1] Noriega-Maldonado O., Bernal-Mendoza LM., Rivera-Nava JC., Guevarra-Torres L. - *Íleo biliar*. Cir. Ciruj. 2005; 73: 443-448.
- [2] Paterson-Brown S., Dudley HAF - *Small bowel obstruction. Obturator obstructions-Gallstone*. In Hamilton Bailey's Emergency Surgery. 12 th edition. Ellis BW., Paterson-Brown S. (ed.), Butterworth Heinemann Ltd. 1995: 450-451.
- [3] Almogly G., Bauer JJ., Venturero M., Present DH. - *Gallstone ileus and Crohn's disease without biliary-enteric fistula: report of a unique case*. The Mount Sinai Journal of Medicine. 2000; 67: 159-162.
- [4] Nakao A., Okamoto Y., Sunami M., Fujita T., Tsuji T. - *The oldest patient with gallstone ileus: report of a case and review of 176 cases in Japan*. Kurumo Medical Journal 2008; 55: 29-33.
- [5] Kirchmayr W., Mühlmann G., Zitt M., Bodner J., Weiss H., Klaus A. - *Gallstone ileus; rare and still controversial*. ANZ J. Surg. 2005; 75: 234-238.
- [6] Richards WO., Williams LF Jr. - *Obstruction of the large and small intestine*. Surg. Clin. North Am. 1988; 68: 355-376.
- [7] Masannat Y., Masannat Y., Shatnawei A. - *Gallstone ileus: a review*. The Mount Sinai Journal of Medicine. 2006; 73:1132-1134.
- [8] Reisner RM., Cohen JR. - *Gallstone ileus. A review of 1001 cases*. Am. Surg. 1994; 60: 441-446.
- [9] Niderle B.I. i dr. *Hirurgia jelcnâh putei*. Praga; Avitenum 1982; 408-412.

- [10] Raiford TS. - *Intestinal Obstruction due to Gallstones*. Ann. Surg. 1961; 153: 830-838.
- [11] Bouveret L. - *Stenose du pylore adherent a la vesicule*. Rev Medicale, (Paris) 1896; Vol XVI: 1-16.
- [12] Muthukumarasamy G., Venkata PS., Shaikh IA., Somani KB., Ravindran R. - *Gallstone ileus: surgical strategies and clinical outcome*. Journal of Digestive Diseases. 2008; 9: 156-161.
- [13] Anseline P. - Colonic gallstone ileus. Postgraduate Medical Journal 1981; 57: 62-65.
- [14] Bohan K.L. - *Biliarnâi ileus po Rossii i bâvșemu SSSR za 100 let, s 1893-1993 g.* Bibliografia atecestvenoi i inostrannoï literaturâ. Deponirovannaia rukopisi. GŢNMB: 1993:172 (in russian)
- [15] Bohan K.L. - *Jelcinokamennaia kișecnaia neprohadimosti*. Vestnik hirurghii 1996; 155:110-112 (in russian)
- [16] Frattaroli FM., Reggio D., Guadalaxara A., Illomei G., Lomanto D., Pappalardo G. - *Bouveret's syndrome: case report and review of the literature*. Hepato-Gastroenterology 1997; 44: 1019-1022.
- [17] Valentin St. John. - *Câteva cazuri de ileus biliar*. Rev. Chirurgie. 1929; XXI: 687-689. (in Romanian)
- [18] Jiano A., Theodoresco D. - *Illeus biliare; operation; guerison*. Rev. Chirurgie. 1933; XXXVI: 217-219.
- [19] Iacobovici I. - *Un cas de calculs gastriques*. Communications. Rev. Chirurgie. 1937; XL:32-34.
- [20] Caloinescu E., Minculescu D., Popescu A., Popovici Gh. - *Experiența a 16 cazuri de ileus biliar*. Comunicare - Al XIV-lea Congres Național de Chirurgie, 1979; 32 (in Romanian)
- [21] Șuteu I., Bucur AL.I. - *Ocluzii intestinale*. În Tratat de patologie chirurgicală, Vol VI, sub redacția E. Proca, București, Ed. Med., 1986; 700-706 (in romanian)
- [22] Beuran M., Venter M.D., Ceaușu I. - *Ileusul biliar aspecte clinico-terapeutice*. Rev. Medicală Națională 1997; 1: 31-35 (in romanian)
- [23] Beuran M., Venter D.M., Păun S. - *Gallstone Ileus: Still a Problem*. EDS. European Digestive Surgery First Meeting. 1998, October 5-8, Barcelona, Spain; 650.
- [24] Ayantunde AA., Agrawal A. - *Gallstone ileus: diagnosis and management*. World J. Surg. 2007; 31: 1292-1297.
- [25] Cooperman AA., Dickerson ER., Remine WH. - *Changing Concepts in the Surgical Treatment of Gallstone Ileus*. Ann. Surg., 1968; 167: 383.
- [26] Moberg AC., Montgomery A. - *Laparoscopically assisted or open enterolithotomy for gallstone ileus*. British Journal of Surgery 2007; 94: 53-57.
- [27] Foss HL., Summers DJ. - *Intestinal obstruction from gallstones*. Annals of Surgery 1942; 115: 721-735.
- [28] Topciașvili Z. A., Kaprov I. B. - *Jelcinokamennaia neprohodimosti*. Vestn. Hir. 1984; 4: 41-46.
- [29] Sánchez AM., Stringel GB., Martinez AT., Fernández CS., Camacho LD., Sánchez RM. - *Surgical management of gallstone ileus: fourteen year experience*. Rev. Gastroenterol. Mex. 2005; 70: 18-23.

- [30] Pracki M., Regula J., Pachlewski J., Rupinski M., Cwikla M., Butruk E. - *Sigmoid laser lithotripsy for gallstone ileus*. Folia Gastroenterol. Hepatol. 2006; 4: 30-32.
- [31] Clavien PA, Richon J, Burgan S, Rohner A. - *Gallstone ileus*. Br J Surg. 1990; 77: 737-42.
- [32] Rodriguez-Sanjuan JC., Casado F., Fernandez MJ., Morales DJ., Naranjo A - *Cholecystectomy and fistula closure versus enterolithotomy alone in gallstone Ileus*. British Journal of Surgery 1997; 84: 634-637.
- [33] Berger F., Rojas C., Iñiguez JI., Santamaria P. - *Íleo biliar resuelto por laparoscopia*. Reporte de un caso. Rev. Chilena de Cirurgia 2005; 57: 511-514.
- [34] Pavlidis TE., Atmatzidis KS., Papaziogas BT., Papaziogas TB. - *Management of gallstone ileus*. J Hepatobiliary. Pancreat. Surg. 2003; 10: 299-302.
- [35] Day EA., Marks C. - *Gallstone ileus*. Review of the literature and presentation of thirty-four new cases. Am. J. Surg. 1975; 129: 552-558.
- [36] Anagnostopoulos GK., Sakorafas G., Kolettis T., Kotsifopoulos N., Kassaras G. - *A case of gallstone ileus with an unusual impaction site and spontaneous evacuation*. J. Postgrad. Med. 2004; 50: 55-56.
- [37] Şabanov A.A., Kaskevici A.P., Juşikovskii S.B. - *Jelcinâi kameni kak pricina ostroi tonkokišecinoi neprohodimosti*. Vestnik Hirurghii 2009;168:102-103 (in russian)
- [38] Armitage G., Fowweather FS., Johnstone AS. - *Observation of bile-acid enteroliths with an account of a recent case*. Br. J. Surg.: 1950; 38: 21-25.
- [39] Beltran MA., Csendes A., Cruces KA. - *The relationship of Mirizzi syndrome and cholecystoenteric fistula: validation of a modified classification*. World J. Surg. 2008; 32: 2237-2243.
- [40] Papavramidis TS, Potsi S, Paramythiotis D, Michalopoulos A, Papadopoulos VN, Douros V, Pantoleon A, Foutzila-Kalogera A, Ekonomou I, Harlaftis N. - *Gallstone obstructive ileus 3 years post-cholecystectomy to a patient with an old ileoileal anastomosis*, J Korean Med Sci. 2009; 24: 1216-1219.
- [41] Yoshida H., Tajiri T., Mamada Y., Taniai N., Hirakata A., Kawano Y., Mizuguchi Y., Arima Y., Uchida E., Uchida E. - *Diagnosis of gallstone ileus by serial computed tomography*. Hepatogastroenterology 2004; 51: 33-35.
- [42] Lassandro F., Romano S., Ragozzino A., Rossi G., Valente T., Ferrara I., Romano L., Grassi R. - *Role of helical CT in diagnosis of gallstone ileus and related conditions*. AJR 2005; 185: 1159-1165.
- [43] Draganic BD., Reece-Smith H. - *Gallstone ileus without a gallbladder*. Ann. R. Coll. Surg. Engl. 1997; 79: 231-232.
- [44] Saedon M., Gourgiotis S., Salemis NS., Majeed AW., Zavos A. - *Gallstone ileus one quarter of a century post cholecystectomy*. Annals of Hepatology 2008; 7 : 258-259.
- [45] Dittrich K., Weiss H. - *Ileus of the small intestine caused by a lost gallstone! A late complication of laparoscopic cholecistectomy*. Chirurg. 1995; 66: 443-445.
- [46] 46. Wills VL., Smith RC. - *Gallstone ileus: post cholecystectomy*. Aust. N. J. J. Surg. 1994; 64: 650-652.
- [47] Gorecki P., Fahoum B., Schein M. - *Delayed gallstone ileus following laparoscopic cholecystectomy*. Surgical Rounds 2001; 24: 266-267.

- [48] Habib E., Elhadad A. - *Digestive complications of gallstones lost during laparoscopic cholecystectomy*. HPB 2003; 5:118-122.
- [49] Ivanov I., Beuran M., Venter MD., Iftimie-Nastase I., Smarandache R., Popescu B., Bostina R. - *Gallstone ileus following laparoscopic cholecystectomy*. Journal Medicine & Life. 2012 (sub tipar).
- [50] Andersson H., Bosaeus I., Fasth S., Hellberg R., Hulten L. - *Cholelithiasis and urolithiasis in Crohn's disease*. Scand. J. Gastroenterol. 1987; 22:253-256.
- [51] Baker AL., Kaplan MM., Norton RA., Patterson JF. - *Gallstones in inflammatory bowel disease*. Dig. Dis. 1974;19:109-112.
- [52] Lapidus A., Einarsson C. - *Bile composition in patients with ileal resection due to Crohn's disease*. Inflammatory bowel disease. 1998;4: 89-94.
- [53] Lowe AS., Stephenson S., Kay KL., May J. - *Duodenal obstruction by gallstone (Bouveret's syndrome): review of the literature*. Endoscopy, 2005; 37:82-87.
- [54] Masson JW., Fraser A., Wolf B., Duncan K., Brunt PW., Sinclair TS. - *Bouveret's syndrome: gallstone ileus causing gastric outlet obstruction*. Gastrointest Endosc 1998; 47: 104-105.
- [55] Ulreich S., Massi J. - *Recurrent gallstone ileus*. AJR 1979; 133: 921-923.
- [56] Guttikonda S., Vaswani KK., Vittelas K. - *Recurrent gallstone ileus: a case report*. Emerg. Radiol. 2002; 9: 110-112.
- [57] 57. Kurguzov O.P. - *Cholelithic small bowel obstruction*. Khirurgiia (Mosk) 2007; 6:13-19.
- [58] Subbotin N.K., Busâriov Y.B., Davâdov M.I. - *Radikalînă operații pri jelcinokamennoi kișecinoi neprohodimosti*. Annalâ hirurgii 2000 ; 4: 31 (in Russian)
- [59] Rodriguez Hermosa JI., Codina Cazador A., Girones Vila J., Roig Garcia J., Figa Francesch M., Acero Fernandez D. - *Gallstone ileus: results of analysis of a series of 40 patients*. Gastroenterol.Hepatol. 2001; 24: 489-494.
- [60] Hildebrandt J., Herrman U., Diettrich H. - *Gallstone ileus. A report of 104 cases*. Chirurg. 1990; 61: 392-395.
- [61] Beliaev A.A., Sveșnicov A.I. - *Jelcinokamennaia kișecinaia neprohodimosti*. Hirurghia 1971; 2: 24-27 (in russian)
- [62] Kovaliov A.P., Dudenco F.I., Lâsenko B.F. - *Jelcinokamennaia neprohodimosti kișecinika kak oslojnenie kalikulioznogo holejstita*. Vestnik Hirg 1990; 7: 46-47.(in russian)
- [63] Kulešov E.V., Temnogradova Z.S., Demidov G.I., Sapojnicov A. Iu. - *Oșibki i opasnosti v hirurghii jelcinâh putei pri razvitii vnutrennego biliodighektivnogo svișia*. Vestnik Hirghii 1985; 11: 133-135 (in russian)
- [64] Fiodorov A.V., Cernova T.G. - *Jelcinokamennaia neprohodimosti tonkoi kișki*. Hirurghia 1992 ;1: 37-41 (in russian)
- [65] Huanafin S.N., Gattarov I.H., Nurmuhametov A.A., Murzin G.A. - *Jelcinokamennaia neprohodimosti kișecinika*. Hirurghia 2002; 4: 57-60 (in russian)
- [66] Șurkalin B.K., Kriger A.G., Homenko V.S., Alekperov Z.M. - *Osobennosti kliniceskoi kartinâ i hirurgiceskogo lecenia jelcinokamennoi kișecinoi neprohodimosti*. Hirurghia 1986; 2: 58-60 (in russian)

- [67] Gorbunov O.M., Şalâginov S.I. - *K hirurgii obturaţionnoi jelcnokamennoi kişecinoi neprohodimosti*. Vestnik Hurg 1990; 3: 40-41 (in russian)
- [68] Klimanskii I.V., Şapovalianţ S.G. - *Diagnostica i lecenie jelcinokamenoii neprohodimosti kişecinika*. Vestnik Hurg 1975; 8: 35-39 (in russian)
- [69] Lâsunet P.B., Serdiuk D.V., Solovievskaia T.M. - *Jelcinokamennaia kişecinaia neprohodimosti*. Hirurghia 1983; 8: 71-73 (in russian)
- [70] Yakan S., Engin Ö., Tekeli T., Çalik B., Dencli AL., Çoker A., Harman M. - *Gallstone ileus as an unexpected complication of cholelithiasis: diagnostic difficulties and treatment*. Turkish Journal of Trauma & Emergency Surgery 2010; 16: 344-348.
- [71] Van Hillo M., Van der Vliet JA. - *Gallstone obstruction of the intestine: an analysis of 10 patients and a review of the literature*. Surgery 1987;101: 273-6.
- [72] Shrake PD., Rex DK. - *Radiographic evaluation of suspected small bowel obstruction*. Am J Gastroenterol 1991; 86: 175-178.
- [73] Ryan AC. - *Intestinal obstruction due to gallstones*. The Canadian Association Medical Journal 1937: 167-168.
- [74] Vikker M.M. - *Neatlojnaia diagnostika i vracebnaia tactika pri ostrîh briusnih zabolevanii*. Rostizdat 1938; 128-130 (in Russian)
- [75] Vanţean E.N. - *Narujnie i vnutrenie svişi v hirurghicescoi cliniche*. Moskva. Mediţina 1990; 117-124 (in Russian)
- [76] Zalikas J., Munson L. - *Complications of gallstones: the Mirizzi syndrome, gallstone ileus, gallstone pancreatitis, complications of "lost" gallstones*. Surg.Clin.N.Am. 2008; 88: 1349-1355.
- [77] Balthazar EJ., Schechter LS. - *Air in gallbladder: a frequent finding in gallstone ileus*. American Journal Roentgenol. 1978;131: 219-222.
- [78] Lassandro F., Gagliardi N., Scuderi M., Pinto A., Gatta G., Mazzeo R. - *Gallstone ileus analysis of radiological findings in 27 patients*. Eur J Radiol 2004; 50: 23-29.
- [79] Garg MK., Galwa RP., Goyal D., Khandelwal N. - *Jejunal gallstone ileus: an unusual site of gallstone impaction*. J Gastrointest Surg 2009; 13: 821-823.
- [80] Reimann AJ., Yeh BM., Breiman RS., Joe BN, Qayyum A., Coakley FV. - *Atypical cases of gallstone ileus evaluated with multidetector computed tomography*. Journal of Computer Assisted Tomography 2004; 28: 523-527.
- [81] Lorén I., Lasson A., Nilsson A., Nilsson P., Nirhov N. - *Gallstone ileus demonstrated by CT*. J. Comput. Assist. Tomogr 1994; 18: 262-265.
- [82] Yu CY., Lin CC., Shyu RY., Hsieh CB., Wu HS., Tyan YS., Hwang JI., Liou CH., Chang WC., Chen CY. - *Value of CT in the diagnosis and management of gallstone ileus*. World Journal of Gastroenterology 2005; 11: 2142-2147.
- [83] Pickhardt PJ., Bhalla S., Balfe DM. - *Acquired gastrointestinal fistulas: classifications, etiologies, and imaging evaluation*. Radiology 2002; 224: 9-23.
- [84] Mateş I.N., Dinu D., Bârlă R., Cherciu B., Constantinoiu S. - *Ocluzia intestinului mezenterial prin calcul biliar (ileus biliar); experienţa clinică şi revizuirea literaturii*. Chirurgia 2002; 97: 263-275.(in Romanian)

- [85] Gan S., Roy-Choudhury S., Agrawal S., Kumar H., Pallan A., Super P., Richardson M. - *More than meets the eye: subtle but important CT findings in Bouveret's syndrome*. AJR Am J Roentgenol 2008;191:182-5.
- [86] Lasson A., Lorén I., Nilsson A., Nirhov N., Nilsson P. - *Ultrasonography in gallstone ileus: a diagnostic challenge*. Eur J Surg 1995; 161: 259-263.
- [87] Dibirov M.D., Fedorov V.P., Martirosyan N.K., Abdulaev E.M., Sychinsky Yu.Î., Dzhadzhiev A.B. - *Clinical course, diagnosis and treatment of cholelithic intestinal obstruction*. Hirurgia 2007; 5: 17-21.
- [88] Shabani AGS., Kelly IMG. - *Sentinel gem-case of the month*. The British Journal of Radiology. 1999; 72: 825-826.
- [89] Grove O. - *Acute pyloric obstruction by gallstone: report of a case diagnosed by gastroscopy*. Gastrointestinal Endoscopy 1976; 22: 212-213.
- [90] Cappell MS., Davis M. - *Characterization of Bouveret's syndrome: a comprehensive review of 128 cases*. The American Journal of Gastroenterology 2006; 101: 2139-2146.
- [91] Arioli D., Venturini I., Masetti M., Romagnoli E., Scarcelli A., Ballesini P., Borghi A., Barberini A., Spina V., Santis M., Benedetto F., Gerunda GE., Zeneroli ML. - *Intermittent gastric outlet obstruction due to a gallstone migrated through a cholecysto-gastric fistula: A new variant of Bouveret's syndrome*. World J Gastroenterol 2008;14: 125-128.
- [92] Pickhardt PJ, Friedland JA, Hruza DS, Fisher AJ. - *CT, MR cholangiopancreatography, and endoscopy findings in Bouveret's syndrome*. AJR. 2003; 180: 1033-1035.
- [93] Taira A., Yamada M., Takehira Y. - *A case of jejuna perforation in gallstone ileus*. Nippon Shokakibyo Gakkai Zasshi 2008; 105: 578-582.
- [94] Venter MD., Marian R. - *Ileus biliar aspecte clinico-terapeutice*. În *Actualități medico-chirurgicale în patologia digestivă*. Sub red. Beuran M., Grigorescu M., Vol Editura Medicală Universitară "Iuliu Hațieganu", Cluj Napoca; 2010: 224-235 (in Romanian)
- [95] Ng WF., Ng CS. - *Acute Wernicke's encephalopathy complicating chronic gallstone ileus*. HKMJ 1998; 4: 235-238.
- [96] Nadu A., Gallili Y., Soffer D., Kluger Y. - *Disruption of Cholecystoenteric Fistula Induced by Minor Blunt Trauma*. Journal of Trauma-Injury Infection & Critical Care 1996; 41: 914-915.
- [97] Dimitriu Victor. *In Chirurgie Semeiologică-Clinică-Terapeutică vol.IV, partea a-7-a*, sub îngrijirea I.Iacobovici. Ocluziile intestinului subțire prin calculi biliari, Tip.Slova, Brăila 1947; Cap. V: 102-104 (in Romanian)
- [98] Chou Jen-Wei., Hsu Chang-Hu., Liao Kuan-Fu., Lai Hsueh-Chou., Cheng Ken-Sheng., Peng Cheng-Yuan., Yang Mei-Due., Chen Yung-Fang. - *Gallstone ileus: report of two cases and review of the literature*. World J Gastroenterology 2007;13:1295-1298.
- [99] Warshaw AL., Bartlett MK. - *Choice of operation for gallstone intestinal obstruction* Annals of Surgery 1966; 164: 1051-1055.
- [100] Doko M., Zovak M., Kopljar M., Glavan E., Ljubicic N., Hochstädter H. - *Comparison of surgical treatments of gallstone ileus: preliminary report*. World J. Surg. 2003;27: 400-404.
- [101] Jarling J., Lorenz D., Schmitting A. - *Gallenstein ileus - Ergebnisse und Probleme der chirurgischen Therapie*. Zbl Chir 1988; 113: 855-859.

- [102] Petroianu A. - *Gallstone obstruction of the jejunum. Case report.* Revista do Hospital Sao Paulo-Escola Paulista de Medicina 1990; 2: 49-50.
- [103] Gencosmanoglu R., Inceoglu R., Baysal C., Akansel S., Tozun N. - *Bouveret's syndrome complicated by a distal gallstone ileus.* World Journal of Gastroenterology 2003; 9: 2873-2875.
- [104] Bhama JK., Ogren JW., Lee T., Fisher WE. - *Bouveret's syndrome.* Surgery 2002; 132: 104-105.
- [105] Zuegel N., Hehl A., Lindemann F., Witte J. - *Advantages of one-stage repair in case of gallstone ileus.* Hepato-Gastroenterology 1997; 44: 59-62.
- [106] Ponomariov A.A., Karpov O.Â. - *Redkie pricinâ neprohodimosti jeludocino-kišecinogo tracta.* Riazani 2002; 224-237 (in Russian)
- [107] Ferraina P., Gancedo MC., Elli F., Nallar M., Ferraro A., Sarotto L., Anzorena FS. - *Video-assisted laparoscopic enterolithotomy: new technique in the surgical management of gallstone ileus.* Surg. Laparosc. Endosc. Percutan. Tech. 2003;13:83-87.
- [108] Montgomery A. - *Laparoscope-guided enterolithotomy for gallstone ileus.* Surg. Laparosc. Endosc. 1993; 3: 310-314.
- [109] Franklin ME Jr., Dorman JP., Schuessler WW. - *Laparoscopic treatment of gallstone ileus: a case report and review of the literature.* J Laparoendosc. Surg. 1994; 4: 265-272.
- [110] Sarli L., Pietra N., Costi R., Gobbi S. - *Gallstone ileus: laparoscopic-assisted enterolithotomy.* J. Am. Coll.Surg. 1998; 186: 370-371.
- [111] Sica GS., Sileri P., Gaspari AL. - *Laparoscopic treatment of Bouveret's syndrome presenting as acute pancreatitis.* Journal of the Society of Laparoendoscopic Surgeons 2005; 9: 472-475.
- [112] Malvaux P., Degolla R., De Saint-HubertM., Farchakh E., Hauters P. - *Laparoscopic treatment of a gastric outlet obstruction caused by a gallstone (Bouveret's syndrome).* Surg Endosc 2002; 16: 1108-1109.
- [113] Krigher A.G., Andreițev I.L., Ovanesian Ȃ.P., Berelavicius S.V. - *Variant obturaționnoi kišecinoi neprohodimosti, obuslovennoi jelcinâmi kamniami.* Hirurghia 2003; 9: 51.(in Russian)
- [114] Qureshi I, Awad ZT. - *Predictors of failure of the laparoscopic approach for the management of small bowel obstruction.* Am. Surg. 2010; 76: 947-50.
- [115] Giurgiu DIN., Roslyn JJ. - *Calculous biliary disease Ch.41. In Surgery: scientific, principles and practice, 2nd edition;* Lazar J. Greenfield., Michael W. Mulholland., Keith T. Oldham., Gerald B. Zelenok., Keith D. Lillemoe (editors); Lippincott-Raven Publishers 1997; 1050.
- [116] Tan YM., Wong WK., Ooi LLPJ. - *A comparison of two surgical strategies for the emerency treatment of gallstone ileus.* Singapore Med. J. 2004; 45: 69-72.
- [117] Ivanov I. - *Ileusul biliar-aspecte clinico-terapeutice.* Teza de Doctorat. UMF Carol Davila. Bucuresti. 2012.(in romanian)
- [118] Jason N. Rogart, Melissa Perkal, Anil Nagar. - *Case Report. Successful Multimodality Endoscopic Treatment of Gastric Outlet Obstruction Caused by an Impacted Gallstone (Bouveret's Syndrome).* Diagnostic and Therapeutic Endoscopy, Volume 2008, Article ID 471512.
- [119] Katsinelos P, Dimiropoulos S, Tsoikas P, Baltagiannis S, Kapelidis P, Galanis I, Papaziogas B, Georgiadou E, Vasiliadis I. - *Successful treatment of duodenal bulb obstruction*

caused by a gallstone (*Bouveret's syndrome*) after endoscopic mechanical lithotripsy. *Surg Endosc.* 2002 Sep;16(9):1363.

[120] Lubbers H., Mahlke R., Lankisch PG. - *Gallstone ileus: endoscopic removal of a gallstone obstructing the upper jejunum.* *J Intern Med* 1999; 246: 593-597.

[121] Fujita N., Noda Y., Kobayashi G. - *Gallstone ileus treated by electrohydraulic lithotripsy.* *Gastrointestinal Endoscopy* 1992; 38: 617-619.

[122] Moriai T., Hasegawa T., Fuzita M., Kimura A., Tani T., Makino I. - *Successful removal of massive intragastric gallstones by endoscopic electrohydraulic lithotripsy and mechanical lithotripsy.* *American Journal of Gastroenterology* 1991; 86: 627-629.

[123] Dumonceau M., Delhaye M., Devi`ere J., Baize M., Cremer M. - *Endoscopic treatment of gastric outlet obstruction caused by a gallstone (Bouveret's syndrome) after extracorporeal shock-wave lithotripsy.* *Endoscopy* 1997; 29: 319-321.

[124] Maiss J., Hochberger J., Muehldorfer S., Keymling J., Hahn EG., Schneider HT. - *Successful treatment of Bouveret's syndrome by endoscopic laserlithotripsy.* *Endoscopy* 1999; 31: S4-S5.

[125] Langhorst J., Schumacher B., Deselaers T., Neuhaus H. - *Successful endoscopic therapy of a gastric outlet obstruction due to a gallstone with intracorporeal laser lithotripsy: a case of Bouveret's syndrome.* *Gastrointestinal Endoscopy* 2000; 51: 209-213.

[126] Alsolaiman MM., Reitz C., Nawras AT., Rodgers JB., Maliakkal BJ. - *Bouveret's syndrome complicated by distal gallstone ileus after laser lithotripsy using Holmium YAG laser.* *BMC Gastroenterolog* 2002; 2: 15-18.

[127] Gemmel C., Weickert U., Eickhoff A., Schilling D., Riemann JF. - *Successful treatment of gallstone ileus (Bouveret's syndrome) by using extracorporeal shock wave lithotripsy and argon plasma coagulation.* *Gastrointest. Endosc.* 2007; 65:173-175.

[128] Hauke Sebastian Heinzow., Tobias Meister., Johannes Wessling., Wolfram Domschke., Hansjoerg Ullerich. - *Ileal gallstone obstruction: Single-balloon enteroscopic removal.* *World J Gastrointest Endosc* 2010; 2: 321-324.

[129] Shenoy VN., Limbekar S., Long PB., Bashar AA. - *Relief of small bowel obstruction following colonoscopy in a case of gallstone ileus.* *J Clin Gastroenterol* 2000; 30:326-328.

[130] Holl J., Sackmann M., Hoffmann R. - *Shock-wave therapy of gastric outlet syndrome caused by a gallstone.* *Gastroenterology* 1989; 97: 472-474.

[131] Apel D., Jakobs R., Benz C., Martin WR., Riemann JF. - *Electrohydraulic lithotripsy treatment of gallstone after disimpaction of the stone from the duodenal bulb (Bouveret's syndrome).* *Italian Journal of Gastroenterology and Hepatology* 1999; 31: 876-879.

[132] Nakamoto Y., Saga T., Fujishiro S., Washida M., Churiki M., Matsuda K. - *Gallstone ileus with impaction at the neck of a Meckel's diverticulum.* *The British Journal of Radiology* 1998; 71: 1320-1322.

[133] Zielinski MD., Ferreira LE, Baron TH. - *Successful endoscopic treatment of colonic gallstone ileus using electrohydraulic lithotripsy.* *World J Gastroenterol* 2010; 16: 1533-1536.