Beyond Bowel Obstruction: A Narrative Review of Gallstone Ileus and its Evolving Surgical Management

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ABSTRACT

Gallstone ileus (GSI) is an uncommon but potentially life-threatening mechanical bowel obstruction caused by impaction of a large gallstone within the small intestine. This unique and interesting condition has an unusual pathophysiology, leading to non-specific clinical presentations, including the characteristic "tumbling phenomenon". Various imaging modalities confirm the diagnosis when the condition is clinically suspected; however, despite their availability, only 50% of patients receive an accurate preoperative diagnosis. The elusive nature of GSI frequently delays diagnosis, leading to high morbidity and mortality. Therefore, early recognition and prompt intervention are crucial for improving patient outcomes. Surgery remains the cornerstone of treatment, most commonly via laparotomy, though laparoscopic and robotic-assisted techniques are increasingly utilized. Nevertheless, the optimal surgical approach remains controversial and an ongoing research topic. This review provides an overview of GSI and evaluates the evidence supporting different surgical strategies, including recent updates in surgical practice. By examining the available data, identifying key factors influencing outcomes, and reviewing the few available guidelines and recommendations, this review contributes to a better understanding of best practices in the surgical management of this challenging condition.

Keywords: Enterolithotomy, gallstone ileus; laparoscopic surgery; one-stage; two-stage

INTRODUCTION

Gallstone ileus (GSI), first described in 1654 by Thomas Bartholin in a necropsy study[1], remains a fascinating and challenging surgical condition that highlights the sometimes complex interplay between the biliary and gastrointestinal systems. The passage of a gallstone from the gallbladder into the small intestine to ultimately cause obstruction - an event that should be physiologically impossible - underscores the remarkable capacity of the human body to adapt and malfunction in unexpected ways. The term "gallstone ileus" is, in fact, a misnomer, as it describes mechanical intestinal obstruction rather than a true ileus, which is paralysis of the bowel[2].

The management of GSI therefore remains an uncommon but fundamental part of surgical practice. Here we provide an overview of GSI and evaluate the evidence supporting different surgical strategies, including more recent advances and approaches. By examining the available data, identifying key factors influencing outcomes, and reviewing existing guidelines and recommendations, we aim to provide a better understanding of best practices in the surgical management of this challenging condition.

LITERATURE SEARCH

We searched the PubMed, EMBASE, and Google Scholar databases for articles published between January 2015 and December 2024 using the search term: "gallstone ileus" AND "surgical management". Additional filters were applied to include only reviews, full-text articles, human studies, and English-language publications. To ensure relevance to modern surgical practices, studies published before 2015 were excluded, as were studies conducted on animals and those published in languages other than English. Abstracts were screened for relevance, full texts of eligible articles were retrieved, and reference lists were also manually searched to identify additional relevant publications.

DEFINITION AND PATHOPHYSIOLOGY

GSI is defined as a small bowel obstruction caused by impaction of a gallstone within the intestinal lumen[1]. However, this seemingly simple definition belies a complex pathophysiological process.

The most common mechanism by which gallstones enter the small bowel is through the formation of a cholecystoenteric fistula, the cornerstone of gallstone ileus[3,4]. This abnormal communication typically occurs between the gallbladder and the proximal duodenum; the stomach, small bowel, and colon are less commonly involved[1]. The fistula allows large gallstones to migrate into the intestinal lumen, often following an episode of cholecystitis, where the pressure, inflammation, and ischemia caused by the offending gallstone erodes the gallbladder wall to form a fistula[5].

Less common routes for gallstones to enter the small bowel include through the common bile duct or a dilated ampulla of Vater. Other reported mechanisms include gallstone transfer after endoscopic retrograde cholangiopancreatography (ERCP) and sphincterotomy with unsuccessful gallstone extraction[6], and, rarely, following laparoscopic cholecystectomy, where a free cholelith erodes into the small bowel over time[1]. Other, even less frequent causes include *in situ* gallstone growth and inadvertent iatrogenic migration of a gallstone during gallbladder manipulation while performing a cholecystectomy[7-9].

Another indirect cause of GSI is after subtotal cholecystectomy, which is sometimes performed in cases of severe cholecystitis to avoid hazardous dissection of a plastered Calot's triangle and to avoid iatrogenic injuries. However, when performing this procedure, the stump of the gallbladder must be free of any remnant stones as complications, such as GSI or persistent biliary fistula, have been documented in association with this procedure[10].

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Once entering the small intestine, gallstones typically migrate distally, ultimately passing through the rectum. However, larger stones may become impacted, causing intestinal obstruction. Less commonly, stones migrate proximally towards the stomach, potentially leading to gallstone emesis[1].

Distal migration can result in stone impaction at various points along the gastrointestinal tract, with the ileocecal valve (Barnard's syndrome) the most common site, followed by the jejunum, duodenum, and colon, respectively[11]. Bouveret described a clinical syndrome (now known as Bouveret syndrome[12,13] that presents as gastric outlet obstruction caused by an impacted gallstone) within the duodenal bulb[1]. Stones have also been known to impact at sites of strictures, such as those caused by Crohn's disease, diverticulitis, or Meckel's diverticula[8,14].

The likelihood of impaction is influenced by several factors, including gallstone size, the location of the fistula, and the diameter of the intestinal lumen[1]. Most gallstones smaller than 2 cm can be excreted spontaneously in the feces. The literature reports a range of sizes for obstructing gallstones. Impacted stones range from 2 to (in extreme cases) 10 cm, with a mean size of around 4.3 cm[1]. Gallstones greater than 5 cm in diameter are more likely to impact, although even 5 cm stones can pass spontaneously[1]. The largest documented gallstone causing intestinal obstruction measured 17.7 cm in its greatest dimension and was retrieved from the transverse colon[1]. Cases involving multiple gallstones have also been described.

EPIDEMIOLOGY AND INCIDENCE

Although precise incidence rates are difficult to determine due to underreporting and variability in diagnostic approaches, the incidence of GSI is thought to be increasing. Estimates suggest that GSI accounts for approximately 1-4% of all cases of mechanical small bowel obstruction[15]. It is also a rare complication of cholelithiasis, affecting 0.5% of cases, increasing to 2-3% in patients experiencing recurrent episodes of cholecystitis[15]. Notably, over half of cases present without a history of biliary disease[2]. The condition predominantly affects older individuals (>65 years), although cases have been reported in younger individuals (13-42 years)[2]. Reflecting the higher prevalence of gallstone disease in women, a female predominance of GSI has been observed[8]. Of note, however, GSI is associated with significant morbidity and mortality risk - 20-57% and 7-18%, respectively - exceeding that of other small bowel obstruction etiologies[5]. Importantly, biliary malignancy may underlie GSI in up to 15% of cases[10,16].

CLINICAL PRESENTATION

The clinical presentation of GSI is variable and often mimics other causes of small bowel obstruction[17]. A quarter to four fifths of patients report prior biliary symptoms, and acute cholecystitis may be co-morbid in 10-30% of cases[1]. Only 15% of patients are jaundiced, and, notably, biliary symptoms may be absent in up to a third of cases[1]. A hallmark feature of GSI is "tumbling obstruction", characterized by transient and recurrent episodes of obstructive symptoms resulting from the intermittent distal passage of gallstones[11]. This unusual "tumbling" phenomenon can delay the presentation and diagnosis.

GSI may be acute, subacute, or chronic[9]. Patients with acute GSI often present with sudden onset abdominal pain, vomiting, and an inability to pass stool. Subacute GSI differs from acute GSI in that the patient does not pass stool but still passes flatus, suggesting partial obstruction. Chronic GSI, also known as Karewsky syndrome, is marked by recurring episodes of abdominal pain as gallstones intermittently traverse the intestinal tract (the "tumbling obstruction" described above).

There are, of course some unusual presentations of GSI. Helmy et al.[10] presented a case of GSI occurring 25 years after laparoscopic cholecystectomy, thought to have arisen on a background of small bowel diverticulosis discovered during surgery for GSI, that may have retained a gallstone for over two decades only to be subsequently dislodged to cause small bowel obstruction. Another reported case of GSI occurred 30 years post-cholecystectomy, where the patient had a large duodenal diverticulum that may have harbored the gallstone that ultimately led to intestinal obstruction[10].

GSI should be suspected in older patients presenting with the Mordor triad: a history of gallstones, signs of acute cholecystitis, and sudden-onset bowel obstruction[9]. However, it is essential to differentiate GSI from other more common causes of bowel obstruction such as postoperative adhesions, incarcerated or strangulated hernias, and abdominal tumors.

DIAGNOSIS

Establishing a diagnosis of GSI requires a high index of suspicion, particularly in elderly patients with a history of gallstones presenting with small bowel obstruction. Imaging modalities play a crucial role in diagnosis.

Rigler's triad, consisting of pneumobilia (Gotta-Mentschler sign), small bowel dilatation, and an ectopic calcified gallstone (eccentric filling defect within the bowel lumen), usually in the right iliac fossa, is the hallmark of GSI[6]. Two out of the three signs are considered diagnostic[9]. However, its sensitivity is limited, ranging from 40% to 70%[6]. While pneumobilia may be present, it is not a definitive indicator of gallstone ileus, as it can also arise following biliary surgery or ERCP or due to sphincter of Oddi dysfunction. Rigler's tetrad includes a fourth radiologic sign of a change in gallstone position on a subsequent abdominal X-ray[9]. Some authors have described two other radiological signs associated with GSI: the Forchet sign, characterized by a clear halo around the stone surrounded by a "snake's head" of contrast, and the Petren sign, which describes the passage of oral contrast through a fistula to the gallbladder[18]. While these features can be identified on plain radiographs, contrast-enhanced computed tomography (CT) is the gold standard imaging modality for diagnosing GSI[9]. CT not only demonstrates Rigler's triad but also offers superior diagnostic accuracy with a sensitivity of 93% and specificity of 100%[1], solidifying its role in the diagnosis of GSI.

The accurate identification of the causative gallstone can be challenging. Only 10% of gallstones are radiopaque[9], making them difficult to visualize on imaging studies. While ultrasonography can effectively identify gallstones within the gallbladder and assess biliary tree anatomy, its direct diagnostic utility in GSI is limited. Despite the availability of advanced imaging, preoperative diagnosis is accurate in only 50% of cases[20].

Non-invasive approaches to GSI management

Although there are reports of successful conservative management of GSI with spontaneous passage of the stone, the mortality rate associated with this approach can be as high as 27%.[11,21] There is therefore a growing trend towards using endoscopic methods, including upper endoscopy, balloon enteroscopy, and colonoscopy for both diagnosis and treatment of GSI, especially in elderly patients or those at high surgical risk. Several case reports have documented the successful endoscopic retrieval of gallstones in GSI, thus obviating the need for surgical intervention. Kishimoto et al[22]. reported a case of GSI in an 85-year-old woman, in whom the obstructing gallstone, measuring 3 cm, was located in the terminal ileum and was successfully removed via lower gastrointestinal endoscopy.

In instances where simple extraction of the stone with a snare or Dormia basket is unfeasible or unsuccessful, the gallstone may be fragmented prior to retrieval[22]. Endoscopic lithotripsy is increasingly used to fragment larger calculi, facilitating their subsequent removal. Several techniques are available, including endoscopic mechanical lithotripsy (EML), endoscopic electrohydraulic lithotripsy (EHL), endoscopic laser lithotripsy (ELL), and even extracorporeal shockwave lithotripsy (ESWL). A potential complication associated with endoscopic management is the risk of distal impaction of gallstone fragments[1].

Historical perspectives and contemporary approaches to the surgical management of GSI

Surgical decompression by enterolithotomy is universally recognized as the mainstay treatment for GSI. However, the optimal extent of surgical intervention remains a subject of debate[5]. Indeed, the surgical management of GSI has undergone significant evolution. Early surgical interventions primarily focused on relieving the obstruction through open enterotomy, often involving manual extraction of the gallstone. However, these procedures were associated with significant morbidity and mortality. The introduction of laparoscopy revolutionized the surgical management of GSI. Minimally invasive techniques offered several advantages over open surgery, including shorter hospital stay, reduced postoperative pain, faster recovery times, reduced morbidity and complications from laparotomy, and improved cosmesis[20,23].

The evolution of laparoscopic GSI management has also significantly advanced. Early laparoscopic enterolithotomy was a technical challenge, often necessitating conversion to laparotomy. However, subsequent refinements in laparoscopic techniques, including the development of specialized instruments and the development of surgical skills including intracorporeal knotting, have substantially improved the success rates of laparoscopic enterolithotomy[24-26]. However, the laparoscopic approach presents several challenges, including the effects of pneumoperitoneum (particularly the risks associated with high insufflation pressures, especially in elderly patients), pre-existing bowel edema secondary to obstruction, and difficulties with port placement and incision closure due to bowel distension[20]. Spillage is also a major concern in the laparoscopic approach. Gari et al.[18] advised several precautions to minimize stone and bowel spillage, including manipulation of the stay sutures, frequent suction, application of an atraumatic intestinal clamp proximal to the enterotomy, placement of 4×4 gauze around the enterotomy site, and using a fashioned endo-bag for stone retrieval. Gari et al.[18] performed laparoscopic enterolithotomy alone in a 61-year-old woman with extensive adhesions and obscured anatomy in the right upper quadrant, and she recovered uneventfully without biliary symptoms necessitating cholecystectomy or fistula closure during two years of follow-up.

Laparoscopic-assisted extracorporeal enterolithotomy offers a potential alternative, mitigating some risks associated with a fully laparoscopic approach. This technique is particularly useful when intracorporeal knotting expertise is limited[20]. Furthermore, the advent of robotic-assisted laparoscopy has further refined these techniques, offering enhanced precision, dexterity, stability, and maneuverability. These advantages are particularly beneficial in managing complex cases, as robotic assistance allows for precise camera and instrument positioning, even in tight anatomical spaces. Agathis et al.[27] reported a successful two-stage robotic approach involving cholecystectomy and cholecystoduodenal fistula repair in an 86-year-old patient. However, there is little published data on the application of robotic surgery to one-stage procedures.

Current surgical management strategies generally fall into three categories: (i) enterolithotomy alone, a relatively straightforward procedure to remove the obstructing intestinal stone; (ii) a one-stage procedure encompassing enterolithotomy, cholecystectomy, and fistula closure, which is technically demanding, prolonged, and carries significant risks; and (iii) a two-stage procedure, which offers the advantage of being simpler and requiring less operative time, consisting of enterolithotomy followed by an interval cholecystectomy and fistula closure[1,5]. Bowel resection is not routinely performed in the management of GSI, being usually reserved for cases where intestinal ischemia has developed.

There is no consensus regarding the optimal surgical approach for the management of GSI[28]. The acute setting presents surgeons with a challenging dilemma: weighing the risks of a one-stage operation against the potential for symptom recurrence after enterolithotomy alone. Regardless, surgical approach selection for GSI necessitates careful consideration of several factors[29]. First, while cholecystoenteric fistulae can spontaneously close, there are no standardized guidelines on the appropriate observation period. Therefore, diligent follow-up is crucial, with some studies suggesting a timeframe of 3–6 months post-lithotomy. Second, persistent cholecystoenteric fistulae pose a risk for recurrent GSI, retrograde cholecystitis, and even gallbladder carcinoma[30-32]. Third, endoscopic extraction following lithotripsy may be ineffective due to the potential for fragment re-impaction.

For high-risk or unstable patients, enterolithotomy alone without immediate biliary intervention is often the preferred approach[33]. This approach involves identification of the obstructing stone, followed by a longitudinal incision in a healthy segment of the bowel proximal to the impaction. The stone is then extracted, and the remaining bowel is meticulously examined for the presence of additional stones. The incision is subsequently closed in a transverse fashion[20]. This strategy allows for initial stabilization and minimizes operative risk. Cholecystectomy can then be considered for patients experiencing recurrent or persistent biliary symptoms[11]. While some small series suggest that most biliary-enteric fistulae close spontaneously following enterolithotomy[11], allowing for the avoidance of biliary intervention in high-risk patients, the risk of recurrent GSI remains a concern. Enterolithotomy alone has been associated with recurrence rates of up to 17% in some series, with the majority occurring within the first six months[11,29] Such recurrences often necessitate further surgical procedures, as illustrated by a case described by Chamberlain et al.[11] Thorough assessment of the gallbladder for residual stones, as well as examination of the entire gastrointestinal tract, is essential to minimize the risk of repeat obstruction and facilitate spontaneous fistula closure[20].

For low-risk patients, however, a one-stage procedure may be suitable. Previously, one-stage procedures were associated with increased mortality compared to enterolithotomy alone. However, more recent data suggest comparable mortality rates (7.5% and 7.8% for the one-stage procedure and enterolithotomy alone, respectively)[11,34], likely attributed to improvements in patient selection, surgical techniques, and perioperative care. Furthermore, one-stage procedures offer the potential benefits of reducing the risk of recurrent GSI, eliminating the residual biliary fistula, and mitigating the associated risks of weight loss, malabsorption, and long-term cholangiocarcinoma[11,35].

In a review of 1001 cases, enterolithotomy alone was proposed as a safe and effective treatment option for GSI based on the lower mortality rate associated with enterolithotomy alone (11.7%) compared with the one-stage procedure (16.9%). In the enterolithotomy-only group, 15% of patients experienced persistent biliary symptoms, with only 10% requiring subsequent surgical interventions for symptom relief. Furthermore, the recurrence rate of GSI in this group was less than 5%[5].

One systematic review and meta-analysis[36], representing 10 studies and 293 patients, compared enterolithotomy alone with one-stage procedures with mortality, morbidity, and operative time as outcome measures. The review found that enterolithotomy alone may be preferable for high-risk patients due to the shorter operative time and reduced risk of mortality and morbidity. While one-stage procedures aim to prevent recurrence, they are still associated with longer operations, increased postoperative complications, and greater postoperative care requirements. Therefore, patient-specific factors, such as overall health and existing comorbidities, should dictate the chosen surgical approach.

Several studies have investigated the optimal surgical approach for GSI. Some report favorable outcomes with enterolithotomy alone compared to more invasive techniques[37]. Others suggest that one-stage procedures should be reserved for low-risk patients. Conversely, when technically feasible, some advocate a one-stage approach[5].

Inukai et al.[29] suggested a treatment strategy tailored to the impaction site. For duodenal impaction, a one-stage procedure is generally preferred, as the cholecystoenteric fistula can often be repaired within the same surgical field. In cases of small bowel impaction, a two-stage procedure may be considered due to the relatively high probability of spontaneous closure of the cholecystoenteric fistula and the potential for lower initial mortality. However, with colonic impaction, spontaneous fistula closure is unlikely, and the risk of reflux cholangitis from fecal contamination is high. Therefore, a one-stage operation is typically the treatment of choice in these cases.

In 2019, Rabie et al.[34] proposed a treatment algorithm for GSI that included three approaches depending on the patient's clinical condition, the extent of inflammation around the gallbladder, the presence of concomitant stones in gallbladder, and the surgeon's expertise. The first two approaches—enterolithotomy alone and a one-stage procedure—are consistent with established surgical practice. However, they also introduced a third option: cholecystolithotomy combined with enterolithotomy to minimize the risk of recurrent GSI. This approach was considered suitable for stable GSI patients presenting with large gallstones (>2 cm) in the gallbladder and moderate surrounding gallbladder inflammation, limiting access for standard cholecystectomy. However, if the gallbladder fundus is well-visualized, allowing safe access, either open or laparoscopic cholecystolithotomy can be performed,[38] which involves incising the gallbladder fundus to extract the stones, irrigating the gallbladder, and closing the incision with absorbable sutures. While potentially beneficial in select cases, cholecystolithotomy is not widely practiced.

The two-stage procedure with scheduled follow-up biliary surgery (usually 4-6 weeks later) is infrequently implemented due to low rates of recurrence and because this population are usually unsuitable for further operations[20]. The reported mortality rate for the two-stage procedure is 2.94%,[1] and it is often recommended in more physically fit patients with persistent biliary symptoms secondary to residual gallstones or the biliary fistula, e.g., biliary colic, acute cholecystitis, weight loss, and malabsorption[20].

Recurrent gallstone ileus (RGSI) primarily occurs in patients whose initial GSI was treated with enterolithotomy alone.[39] However, Mir et al[39]. reported two RGSI cases following a one-stage procedure with cholecystoenteric fistula repair during the initial operation. The authors suggested that the recurrences may have been due to pre-existing, but missed, stones within the bowel, highlighting the difficulty in predicting RGSI risk at the time of the first procedure. Therefore, the identification of multiple stones at the outset is likely to be beneficial. While a preoperative CT scan may assist, careful manual searching for additional stones during the operation is crucial. In this regard, the shape of the index stone can be a useful indicator: the presence of a faceted or cylindrical stone during the first surgery suggests the presence of multiple stones. Although most studies do not report the shape of the stones, those that did showed that 83.3% of stones were faceted[39]. This suggests that searching for additional stones is likely to be both necessary and productive in most cases. Like primary GSI, RGSI is generally treated surgically, falling into the same three categories. Although a series of eight conservatively managed cases has been reported[39] the substantial mortality rate (25%) observed in this group suggests that such an approach should be avoided except in patients with absolute contraindications to surgery due to severe comorbidities.

Currently, there are no universally accepted guidelines on the optimal surgical management of GSI, including the choice between a one-stage and a two-stage procedure[34].

There are several known postoperative complications following the surgical management of GSI. These can be broadly categorized into general surgical complications, such as wound infections, pneumonia, and urinary tract infections, and those specific to the surgical intervention for gallstone ileus. Among the latter, bowel obstruction due to postoperative adhesions or strictures at the surgical site is a recognized risk. Several studies have shown no significant difference in postoperative complications between patients undergoing enterolithotomy alone and those receiving a one-stage procedure,[1] while other studies have reported higher morbidity rates in patients undergoing more complex procedures, such as the one-stage procedure[36]. However, the overall rate of immediate postoperative complications was higher when the diagnosis of GSI was made intraoperatively rather than preoperatively. The most frequent postoperative complication is acute renal failure, occurring in approximately 30% of patients. Other notable complications include urinary tract infections (13.79%), ileus (12.42%), anastomotic leak, intra-abdominal abscess, and enteric fistula (12.27%), as well as wound infections (7.73%)[1].

Several factors contribute to the high mortality associated with GSI. The condition predominantly affects elderly individuals, who frequently present with comorbidities such as cardiorespiratory disease and/or diabetes mellitus[1]. The atypical symptoms often hinder prompt diagnosis, resulting in a reported average four-day delay between symptom onset and hospital admission[1]. Finally, age-related postoperative complications, including pneumonia and cardiac failure, are more common than complications directly attributable to the surgical procedure[1].

However, mortality rates have decreased substantially in recent years,[1] with many studies reporting no postoperative mortalities[36]. This decline is likely due to several factors, including increased awareness of GSI among healthcare professionals, improved diagnostic imaging, advances in surgical techniques, and better pre- and postoperative care. The observed variation in mortality rates associated with different surgical approaches for GSI across various studies is probably multifaceted rather than simply a reflection of the surgical technique. Several potential confounders warrant consideration when interpreting these data. Patient demographics, including age and comorbidities, significantly influence overall surgical risk. Variations in the proportion of high-risk patients across studies can substantially impact reported mortality. Furthermore, the severity and duration of ileus at presentation, including the presence of bowel ischemia, perforation, or sepsis, are critical prognostic factors independent of the surgical approach. Differences in disease burden between studies

can thus contribute to divergent mortality rates. Surgical expertise and experience also play a crucial role, with surgeons specializing in complex gallstone ileus cases potentially achieving superior outcomes. Variations in surgical skills and institutional experience can influence mortality.

Methodological factors, such as study design (retrospective vs. prospective) and sample size, can further contribute to discrepancies. Retrospective studies may be prone to inherent biases, while prospective studies may have limitations in patient selection. Postoperative care protocols, including intensive care availability and management of complications, can also influence patient outcomes. Finally, variations in the definition of mortality (e.g., in-hospital, 30-day, 90-day) across studies can complicate comparisons. Therefore, when evaluating mortality data related to surgical approaches for GSI, it is essential to acknowledge these confounding variables. Direct comparisons between studies should be undertaken cautiously, considering the potential impact of patient characteristics, disease severity, surgical expertise, study design, and postoperative management. Large-scale, well-designed prospective studies are ideally suited to definitively assess the relative safety and efficacy of different surgical strategies and to identify optimal treatment algorithms for specific patient populations.

Indications for a one-stage procedure

The decision to undertake a one-stage procedure for GSI relies on a multifactorial assessment. Key considerations include the surgeon's experience, the patient's overall health, and the specific protocols and guidelines established within the healthcare institution. Potential candidates for a one-stage approach are typically hemodynamically stable, present with less severe disease, have been adequately optimized preoperatively, have fewer comorbid conditions, are younger, and have a low predicted risk of postoperative complications[20]. Moreover, the availability of a surgical team possessing expertise in both enterolithotomy and cholecystectomy is crucial. A review of the literature underscores a consensus among surgeons that the one-stage procedure should be judiciously applied and reserved for carefully selected cases.

Best practices in surgical management

The optimal management of GSI demands a multifaceted approach that includes meticulous preoperative evaluation, perioperative care, and surgical technique.

Preoperatively, a thorough assessment is critical and must include a comprehensive medical history, a detailed physical examination, and appropriate laboratory and imaging investigations.

Perioperative care must be meticulous. This includes vigilant fluid and electrolyte management, effective pain control, and early mobilization to minimize the risk of postoperative complications such as pneumonia and deep vein thrombosis.

Finally, successful surgical outcomes are contingent upon meticulous surgical techniques. This necessitates careful dissection, optimal visualization of the surgical field, and meticulous hemostasis to minimize intraoperative blood loss and potential complications.

Implications for clinical practice

The findings of this literature review have several important implications for clinical practice. Surgeons should be well-informed about the potential benefits and risks of both one-stage and two-stage procedures when counseling patients with GSI. Careful patient selection is crucial to identify suitable candidates for one-stage procedures. Successful outcomes are more likely to be achieved by experienced surgeons with expertise in both laparoscopic enterolithotomy and cholecystectomy, particularly within high-volume centers with dedicated teams experienced in managing complex laparoscopic procedures. Meticulous perioperative care, including appropriate fluid and electrolyte management, pain control, and early mobilization, is essential for optimizing patient outcomes (Table 1).

Continuous quality improvement initiatives, including ongoing data collection and analysis, are crucial for monitoring outcomes, identifying areas for improvement, and refining surgical techniques. Additionally,

Table 1. Key factors influencing outcomes in GSI.

Category	Specific Factor	Impact on Outcome
Patient-Related	Age	Older age increases risk of complications due to comorbidities and reduced physiological reserve.
	Comorbidities	Presence of other medical conditions (e.g., cardiovascular disease, diabetes) worsens prognosis.
	Nutritional Status	Malnutrition negatively affects wound healing, immunity, and recovery.
	Overall Health Status	Frailty, poor functional status, and decreased immune response increase the risk of complications and mortality.
Disease-Related	Impaction Location	Location influences surgical complexity and risk of complications (e.g., colonic impaction and cholangitis).
	Obstruction Duration	Prolonged obstruction leads to dehydration, electrolyte imbalances, bowel ischemia, and perforation, worsening the prognosis.
	Gallstone Size/Nature	Larger stones increase the likelihood of impaction and may require more extensive surgery.
	Presence of Complications	Bowel ischemia, perforation, abscess, or sepsis significantly increase the risk of adverse outcomes.
Treatment-Related	Surgical Approach	Choice of one-stage vs. two-stage procedure and extent of bowel resection impacts outcomes.
	Surgery Timing	Prompt intervention is crucial to prevent complications.
	Surgical Expertise	Surgeon's skill and experience are vital for successful outcomes.
	Postoperative Care	Adequate fluid/electrolyte management, nutritional support, and complication monitoring are essential.
Other	Diagnosis Delay	Delays lead to prolonged obstruction and increased morbidity.
	Healthcare Access	Timely access to diagnosis and surgical intervention influences outcomes.

the development of predictive models to identify patients who are most likely to benefit from one-stage procedures could significantly aid in clinical decision-making.

CONCLUSION

A thorough understanding of GSI, including its clinical manifestations and radiological findings, is crucial for early diagnosis and optimal patient outcomes. GSI necessitates prompt surgical management due to its potential for life-threatening complications. Although one-stage procedures are increasingly used to minimize recurrence risk, they can be associated with increased morbidity, longer operative times, and prolonged recovery, making careful patient selection and timely intervention essential. Enterolithotomy alone remains a preferred surgical approach for many surgeons due to its reduced morbidity and mortality risk and shorter operative time, particularly in high-risk patients. Our literature review reveals that there is still no consensus on the optimal surgical approach for managing GSI. Some recent studies have explored using the site of impaction to guide surgical decisions, while others still rely on surgeon discretion, individual patient assessment, and existing comorbidities. We believe these factors will likely continue to guide surgical decision-making.

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REFERENCE

1. Nuño-Guzmán CM, Marín-Contreras ME, Figueroa-Sánchez M, et al. Gallstone ileus, clinical presentation, diagnostic and treatment approach. World J Gastrointest Surg. 2016;8(1):65-76.
2. Muñoz-Leija MA, Alemán-Jiménez MC, Quiroga-Garza A, et al. Gallstone ileus in a young patient: a clinical case report and literature review. Cureus. 2023;15(1):e33291.
3. Assali S, Mourany J, Jones B, et al. Technical approach to laparoscopic examination of the small bowel in gallstone ileus. Case Rep Surg. 2020;2020(1):8852804.
4. Erdas E, Medas F, Salaris C, et al. Gallstone ileus in elderly patients. Minerva Chir. 2018;73(6):620-3.
5. Tsang CF. A rare case of gallstone ileus-the unanswered question. J Surg Case Rep. 2021;2021(4):rjab164.
6. Kosco E, Keener M, Waack A, et al. Radiological diagnosis and surgical treatment of gallstone ileus. Cureus. 2023;15(5):e38481.
7. Alemi F, Seiser N, Ayloo S. Gallstone disease: cholecystitis, Mirizzi Syndrome, bouveret syndrome, gallstone ileus. Surg Clin North Am. 2019;99(2):231-44.
8. Chang L, Chang M, Chang HM, et al. Clinical and radiological diagnosis of gallstone ileus: a mini review. Emerg Radiol. 2018;25(2):189-96.
9. Ploneda-Valencia CF, Gallo-Morales M, Rinchon C, et al. Gallstone ileus: An overview of the literature. Rev Gastroenterol Mex. 2017;82(3):248-54.
10. Helmy NA, Ryska O. Gallstone Ileus Post-cholecystectomy: A Case Review. Cureus. 2023;15(1):e33345.
11. Chamberlain SL, Ackermann T, Naqash N. A Rare Case of Recurrent Gallstone Ileus. ACS Case Rev Surg. 2023;4(2):30-4.
12. Jakubauskas M, Luksaite R, Sileikis A, et al. Gallstone ileus: management and clinical outcomes. Medicina. 2019;55(9):598.
13. Joshi M, Nguyen C, Andrade J, et al. Feasibility of laparoscopic-assisted approach in management of gallstone ileus. Am Surg. 2019;85(2):93-6.
14. Orellana M, Vegas L, Cáceres A, et al. Laparoscopic management of gallstone ileus: a case report and literature review. Int J Surg Case Rep. 2021;85:106171.
15. Al-Mudares S, Kurer M, Koshy RM, et al. An unusual presentation of gallstone ileus: a red-herring or missed diagnosis. Am J Case Rep. 2016;17:301-4.
16. Mikhaylov-Schrank Y, Jordan M, Chowdhary S, et al. Laparoscopic management of gallstone ileus. Am Surg. 2018;84(2):e89-e90.
17. Shrestha N, Mishra A, Ghimire R. An unusual case of subacute small bowel obstruction-Gallstone ileus. Int J Surg Case Rep. 2022;92:106820.
18. Mirza Gari MK, Eldamati A, Foula MS, et al. Laparoscopic management for gallstone ileus, case report. Int J Surg Case Rep. 2018;51:268-71.
19. Aldo C, Lorenzo M, Olgerta L, et al. Rolling in the deep: imaging findings and diagnostic pearls in gallstone ileus. Surg Res Pract. 2020;2020(1):1421753.
20. Hussain J, Alrashed AM, Alkhadher T, et al. Gall stone ileus: Unfamiliar cause of bowel obstruction. Case report and literature review. Int J Surg Case Rep. 2018;49:44-50.
21. Takata H, Yoshida H, Hirakata A, et al. Recurrent gallstone ileus successfully treated with conservative therapy. J Nippon Med Sch. 2015;82(6):300-3.
22. Kishimoto M, Okamoto Y, Muroya T, et al. A Case Report on Gallstone Ileus Treated with the Endoscopy. Open J Emerg Med. 2021;9(4):188-95.
23. Cadili L, Streith L, Segedi M, et al. Management of complex acute biliary disease for the general surgeon: a narrative review. Am J Surg. 2024;231:46-54.
24. Coisy M, Bourgouin S, Chevance J, et al. Laparoscopic management of gallstone ileus. J Gastrointest Surg. 2016;20(2):476-8.
25. Gupta AK, Vazquez OA, Yeguez JF, et al. Laparoscopic approach for gallstone ileus in geriatric patients. Cureus. 2020;12(6):e8642.
26. Lee MJ, Sayers AE, Wilson TR, et al. Current management of small bowel obstruction in the UK: results from the National Audit of Small Bowel Obstruction clinical practice survey. Colorectal Dis. 2018;20(7):623-30.
27. Agathis AZ, Ray K, Sharma B, et al. Interval robotic cholecystoduodenal fistula repair and cholecystectomy for gallstone ileus: a case report. J Surg Case Rep. 2024;2024(10):rjae628.
28. Beji H, Chtourou MF, Zribi S, et al. Gallstone ileus: A case report and review of the literature. Int J Surg Case Rep. 2023;106:108221.
29. Inukai K. Gallstone ileus: a review. BMJ Open Gastroenterol. 2019;6(1):e000344.
30. Bourgouin S, Lamblin G, Rose P, et al. Minimally invasive management of gallstone ileus with cholecystoduodenal fistula. ANZ J Surg. 2018;88(10):1081-83.
31. Lee CK, Ramcharan DN, Alaimo KL, et al. Cholecystoduodenal fistula evading imaging and endoscopic retrograde cholangiopancreatography: a case report. Cureus. 2021;13(11):e20049.
32. Ramrakhiani H, Simpson N, Strichartz SD, et al. Like a "rolling" gallstone: cholecystoduodenal fistula as evidence of gallstone ileus. Dig Dis Sci. 2020;65(9):2518-20.
33. Augustin G, Bruketa T, Kunjko K, et al. Colonic gallstone ileus: a systematic literature review with a diagnostic-therapeutic algorithm. Updates Surg. 2023;75(5):1071-82.

34. Rabie MA, Sokker A. Cholecystolithotomy, a new approach to reduce recurrent gallstone ileus. Acute Med Surg. 2019;6(2):95-100.
35. Rodriguez JER, Grossi AELMT, Siqueira VR, et al. Gallstone ileus associated with cholecystogastric fistula: case report, diagnosis and surgical treatment. Int J Surg Case Rep. 2021;86:106328.
36. Vadher D, Zacken A, Shah V, et al. The Rolling Stones: A Systematic Review and Meta-Analysis of the Management of Gallstone Ileus. Chirurgia (Bucur). 2024;119(5):483-514.
37. Scuderi V, Adamo V, Naddeo M, et al. Gallstone ileus: monocentric experience looking for the adequate approach. Updates Surg. 2018;70(4):503-11.
38. Koganti D, Doane S, Palazzo F, et al. Cholecystotomy with stone retrieval: a novel approach for the management of gallstone ileus. Am Surg. 2017;83(1):e30-2.
39. Mir SA, Hussain Z, Davey CA, et al. Management and outcome of recurrent gallstone ileus: a systematic review. World J Gastrointest Surg. 2015;7(8):152-9.