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REVIEW ARTICLE

Incidental Gallstones

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Abstract

Gallstones develop in approximately 10% to 15% of the US population and represent one of the most common and most costly of all digestive diseases. Studies investigating gallstones' natural history have shown that gallstone-related complications arise at a rate of approximately 1% per year in asymptomatic patients and 2% per year in patients who already have symptoms. Patients can have any of multiple presentations with gallstone-related problems along a continuum of health threats from intermittent biliary colic to septic shock from ascending infections. In most clinical situations in which the patient's gallstone symptoms are either recurrent or have caused complications, cholecystectomy remains the procedure of choice. Laparoscopic cholecystectomy, first performed in the mid-1980s, has quickly become the gold standard in the US. For clinicians who perform abdominal procedures, the literature is consistent in advocating cholecystectomy for gallstones found incidentally during other abdominal procedures.

Prevalence and Demographics of Gallstone Disease

Gallstones represent the most common and costly of all digestive diseases, with an estimated overall financial burden in the US of more that $5 billion. From a consensus statement published by the National Institutes of Health (NIH), approximately 10% to 15% of the US adult population has gallstones.[1] Epidemiologic studies estimate the number of gallstone patients in the US to be approximately one million per year. Since the 1980s, we have gained insight to major risk factors for the development of gallstones, including increasing age, female sex, obesity, pregnancy, rapid weight loss, systemic illnesses such as liver disease or hematologic disorders, a long list of medications, and specific bowel surgery.

Historical Perspective on Gallbladder Surgery

The first recorded surgery performed on the biliary system was in 1867 in Indianapolis, IN, when John Stough Bobb operated on a woman with massive gallbladder hydrops. Bobb performed an open cholecystostomy, extracted the gallstones, and then sutured the gallbladder closed. Approximately 15 years later in Berlin, Carl Langebuch performed the first cholecystectomy on a patient with biliary colic. This became the standard operation for patients with symptomatic gallbladder disease for more than 100 years until Erich Mühe revolutionized the field in 1985 in Boeblingen, Germany by performing the first laparoscopic cholecystectomy.[2] In less than one decade, >90% of cholecystectomies performed in the US were being performed laparoscopically.

Since the early 1990s, continual improvement has been made in both the instrumentation and optics needed to perform the laparoscopic cholecystectomy. With ongoing research on indications, methods, and outcomes, a great deal of experience with laparoscopic cholecystectomy has been amassed worldwide.

Natural History of Gallstones

Studies have shown that the vast majority of patients with gallstones will remain asymptomatic throughout life.[3] The reason a subgroup of individuals will ultimately develop symptoms remains unknown; however, once symptoms arise, the recurrence rate is high and risk of progression to gallstone-related complications is significantly increased.[4] An article by colleagues from the Kaiser Permanente Medical Care Program in Oakland, California,[5] reported that 289 patients with documented gallstones were monitored for up to 25 years after diagnosis. Using life-table analysis, the researchers found that complications developed in approximately 1% per year of asymptomatic patients with gallstones and in about 2% per year of symptomatic patients. These figures are similar to those in



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other published reports[1] that ultimately conclude that patients with symptomatic gallstones should be treated. Because nearly two-thirds of asymptomatic patients with gallstones remain symptom free, prophylactic cholecystectomy is rarely indicated and performed only under certain circumstances.

Spectrum of Presentation

Chronic Cholecystitis

As the NIH consensus statement notes,[1] gallstone patients present in one of three clinical stages: asymptomatic, symptomatic, and with complications. Approximately two-thirds of symptomatic patients present with chronic cholecystitis characterized by pain that is severe and episodic, epigastric or right upper quadrant in location, that lasts one to five hours, and that often wakes the patient at night or beginning after a fatty meal. This pain is most often caused by a gallstone obstructing the cystic duct, the sole biliary outflow tract of the gallbladder. This leads to progressively increasing gallbladder wall tension and thus to pain. Nausea and vomiting are commonly associated symptoms.

The diagnosis of chronic cholecystitis or symptomatic cholelithiasis is made when the typical symptoms are present and gallstones are found using various imaging modalities. Abdominal ultrasonography remains the gold-standard diagnostic test, capable of detecting >90% of gallstones. Occasionally, gallstones are found incidentally during abdominal radiographs or computed tomography (CT) scans. In these cases, ultrasonography of the formal right upper quadrant should be performed before surgery.

After its introduction in 1987, laparoscopic cholecystectomy quickly became the standard of care for symptomatic individuals. Long-term results have shown that laparoscopic cholecystectomy eradicates symptoms in approximately 90% of patients with typical biliary symptoms.[6]

Acute Cholecystitis

Once a gallstone has obstructed the cystic duct for an extended period of time, inflammation of the gallbladder wall causes it to become grossly thickened and edematous and may lead to the formation of pericholecystic fluid. These findings represent the cornerstones of diagnosing acute cholecystitis. If the obstruction and contamination are not relieved, inflammation can evolve into infection and abscess formation, creating a gangrenous gallbladder. Uncommonly, this may lead to free perforation of the gallbladder wall, causing development of peritonitis, development of fistulas into adjacent organs, or formation of intra-abdominal abscesses. The symptoms of acute cholecystitis are similar to those of chronic cholecystitis, but in contrast to typical biliary colic, the pain does not regress and may last for several days if untreated. Associated symptoms are broadened to include fever, chills, and anorexia. Physical examination will often show focal tenderness with guarding. A classic characteristic of acute cholecystitis is the finding of Murphy sign, or an inspiratory arrest on deep palpation of the gallbladder in the right upper quadrant.[7] Also in contrast to chronic cholecystitis, in which laboratory study results are generally normal, leukocytosis with white blood cell counts >12,000 cells/mm^3 is commonly present. Levels of other substances for which patients are tested, such as those for liver function (alkaline phosphatase, transaminases, and bilirubin), may be elevated.

Diagnosis is most often confirmed using ultrasonography, which may show gallstones, a thickened gallbladder wall, and fluid next to the gallbladder. For atypical cases or for those in which the diagnosis is uncertain, biliary radionuclide imaging, such as hepatobiliary iminodiacetic acid scans, may be helpful. The finding consistent with acute cholecystitis is the lack of filling of the radionuclide into the gallbladder within four hours, indicating obstruction of normal biliary flow from the liver into the gallbladder.

Cholecystectomy, whether open or laparoscopic, is the treatment of choice for acute cholecystitis.[8] One area of controversy in recent years has been the timing of cholecystectomy in acute cholecystitis. A prospective, randomized study by Lo et al[9] found that barring patient-related factors that would rule out surgery, early cholecystectomy (within two or three days of initial symptoms) should be recommended to patients because it offers a definite solution in one hospital admission, results in quicker recovery times, and also allows for earlier return to work. When patients present after the initial window of opportunity for cholecystectomy (after three or four days of initial symptoms), they can be treated with antibiotics and then scheduled for interval laparoscopic cholecystectomy after six to eight weeks. Of these patients, this therapy will fail in approximately 20%, who will require surgery sooner. The concern about attempting laparoscopic cholecystectomy outside of the initial or late windows is due to the increased rate of conversion to an open procedure, which is associated with increased pain, longer hospitalizations, and obvious cosmetic drawbacks.[10] For patients unfit for surgery, drainage of the gallbladder using either a percutaneous approach through the

liver or an open approach in conjunction with a tube or drain can be performed. This tube can ultimately be removed once a contrast study through the tube shows a patent cystic duct. Laparoscopic cholecystectomy can be performed after the tube has been removed.

Choledocholithiasis

Stones that are found within the common bile duct arise in two ways: 1) secondary migration of gallstones formed in the gallbladder down the biliary tree or 2) primary formation within bile duct. The majority of ductal stones in the US are formed secondarily within the gallbladder.

The spectrum of clinical manifestations in choledocholithiasis is vast, from asymptomatic to complete obstruction with resulting pain, infection, and pancreatitis. Patients report similar biliary colic–type symptoms, with nausea and vomiting commonly associated. These symptoms may be more temporal, causing pain and jaundice as the gallstone temporarily obstructs the bile duct, acting like a ball-valve mechanism. Because the gallstone may completely obstruct the normal flow of bile, patients may become jaundiced and levels of liver function tests, including alkaline phosphatase, serum bilirubin, and transaminases, may be elevated.

The most common cause of cholangitis is gallstones, but any disease process that leads to obstruction may precipitate cholangitis, such as bile duct strictures, parasites, external compression, and blocked biliary stents.

Ultrasonography is commonly the first test obtained to document stones in the gallbladder as well as the size of the common bile duct. A dilated common bile duct (>8 mm in diameter) in conjunction with jaundice, biliary colic, and appropriate elevations in levels of substances measured by laboratory studies is suggestive of choledocholithiasis. Other noninvasive studies, such as magnetic resonance cholangiography, may also provide further details about the biliary system. Endoscopic retrograde cholangiography (ERC) not only is the gold standard for diagnosing common bile duct stones but also is potentially therapeutic if stones are extracted from the common bile duct or sphincterotomy is performed to relieve an obstructing stone.[11]

Common bile duct stones can either be relieved by sphincterotomy and ductal clearance through preoperative ERC or extracted via intraoperative common bile duct exploration through the cystic duct or common bile duct. ERC may also be performed postoperatively when common bile duct stones encountered during routine laparoscopic cholecystectomy. Choledochotomy or common bile duct exploration can be performed laparoscopically or in an open fashion; in either case, a T-tube drain should be left in place to drain bile and stones to the level of the skin. In the case of an abnormally dilated bile duct secondary to impacted stones in the ampulla, anastomosing segments of bowel, such as in choledochoduodenostomy or choledochojejunostomy, may be the best option.

Cholangitis

Acute cholangitis occurs when a stone either partially or completely obstructing the common bile duct causes bacterial contamination and leads to an ascending infection of the biliary system. Immunoglobulins within the bile and a continuous downward flow from the liver normally keep bile sterile. The most common cause of cholangitis is gallstones, but any disease process that leads to obstruction may precipitate cholangitis, such as bile duct strictures, parasites, external compression, and blocked biliary stents. Cultures taken of the bile, of stones within the common bile duct, and of stents produce positive findings in >90% of cases. The most common microbiologic sources are Gram-positives and Gram-negatives: *Escherichia coli* (25%–50%), *Klebsiella pneumoniae* (15%–20%), *Enterococcus* (10%–20%), and *Enterobacter* (5%–10%).[12]

The spectrum of clinical presentation varies widely from mild, intermittent pain to life-threatening septic shock. The classic Charcot triad, consisting of fever, right upper quadrant pain, and jaundice, is present in approximately 50% to 75% of patients with cholangitis.[13] This triad may progress to Reynolds pentad, which adds mental-status changes and septicemia-associated hypotension to the presentation. Physical examination findings are similar to those for patients with acute cholecystitis.

Laboratory findings will often show leukocytosis with elevation in serum bilirubin levels, transaminases, and alkaline phosphatase. Ultrasonography is useful in documenting the presence of gallstones as well as the diameter of the common bile duct. The initial treatments for acute cholangitis are intravenous broad-spectrum antibiotics, aggressive fluid resuscitation, and ultimately drainage of the infected bile, either externally through the skin or within the duodenum through the ampulla of Vater.[14] Many patients will need intensive care unit monitoring and temporary vasopressors.

Endoscopic retrograde cholangiopancreatography (ERCP) is useful in both confirming the diagnosis and with sphincterotomy or stone extraction relieving the obstruction. A stent may have to be placed to allow for drainage of bile. When ERCP is not available, percutaneous transhepatic cholangiography (PTC) may have to be used. It can demonstrate the level of obstruction, allow for bile culturing, and establish a route for drainage of bile, removal of stones, and tube placement. When neither ERCP nor PTC is available, open surgery to

decompress the biliary system with T-tube placement is the treatment of choice. Cholecystectomy can be performed electively once the obstruction is relieved and infection has been controlled.

Gallstone Ileus

Rarely, gallstones can cause a mechanical bowel obstruction in the distal segments of the small intestine, known as gallstone ileus. It occurs in <0.5% of patients with gallstones and is the cause of 1% to 4% of all cases of bowel obstruction. There is a strong female predilection, with gallstone ileus being 3 to 10 times more common in women than in men.[15] The most common mechanism of gallstones causing ileus is a biliary-enteric fistula, which is created after local inflammation causes adhesion formation between the bile duct and intestine. Ongoing inflammation leads to necrosis between the biliary system and the small bowel, leading to communication between the two organ systems. Presenting symptoms are related to mechanical bowel obstruction that causes episodic vague abdominal pain, nausea, and vomiting. The diagnosis is confirmed through plain radiographs and computed tomography scans that demonstrate signs of mechanical bowel obstruction, air within the biliary tree (pneumobilia), or sometimes even the offending stone. Treatment of gallstone ileus remains controversial because there are various opinions regarding the management of the biliary-enteric fistula. Those who advocate a one-stage procedure, by removing the stone, managing the fistula, and cholecystectomy, agree that it is reserved for patients with low surgical risk.[16] With regard to the small bowel, a longitudinal enterotomy is made to carefully remove the stone and is subsequently closed transversely to prevent bowel stenosis.[17]

Incidental Cholelithiasis

Gallstones detected either before or at the time of another gastrointestinal procedure present a difficult and long-debated problem for surgeons. There are arguments both for and against: the possibility of adding significant morbidity and mortality to the index procedure versus the likelihood that biliary symptoms and complications will develop in the future. Of utmost importance when dealing with this issue is an understanding of the natural history of asymptomatic gallstones. As already stated, the complication rate in the US for asymptomatic patients with gallstones is approximately 1% per year. Because of this low rate of progression, prophylactic cholecystectomy as the sole procedure, meaning performing cholecystectomy for the purpose of removing the gallbladder and the associated stones, is rarely indicated.

What does one do when a patient will receive abdominal surgery and the gallbladder can be easily removed? The authors of the 1992 NIH Consensus Statement wrote: "It remains controversial whether incidental cholecystectomy during nonbiliary abdominal surgery in asymptomatic individuals is beneficial."[1]

Despite this statement, there are numerous reports in the literature that support performing incidental cholecystectomy in conjunction with another abdominal procedure, such as from vascular,[18] colorectal,[19] and thoracic[20] surgeries. Juhasz et al[19] reported on a single-institution retrospective review over five years that identified 305 patients who underwent colorectal surgery. Of that cohort, 195 (63.9%) had incidental cholecystectomy that was discovered before, during, or within one month after surgery. Patients were excluded if they developed biliary symptoms before surgery. Using surgical morbidity and long-term complication rates as outcomes, Juhasz et al concluded that incidental cholecystectomy was not associated with increased postoperative morbidity. Furthermore, they found that 14.6% of patients who did not receive cholecystectomy despite having gallstones went on to develop biliary symptoms after a median follow-up period of six years. Twelve of those 16 patients ultimately underwent cholecystectomy.

In a similar study examining patients who underwent incidental cholecystectomy during laparoscopic antireflux surgery, Klaus et al[20] had a much smaller cohort (67 of 1065, or 6.3%) who underwent combined surgery. The goal of the study was to compare the outcomes for patients who underwent cholecystectomy with outcomes for those who underwent fundoplication alone. Using questionnaires to gather information about postoperative symptoms related to gallstones such as abdominal pain, nausea, and vomiting, the authors found no significant difference between groups. They concluded that concomitant laparoscopic cholecystectomy did not influence the outcome of the index surgery and is a safe procedure. The literature supports performing cholecystectomy in conjunction with another abdominal procedure. As long as the surgeon is comfortable performing it, doing so does not put the patient at significant additional risk or significantly increase the duration of the index procedure. ❖

Disclosure Statement

Jeffrey K Wang, MD, and Shannon Foster, MD, have no conflicts of interest to disclose. Bruce Wolff, MD, FACS, is a consultant for Tranzyme Pharma, Roche, and Cenzone Tech, Inc.

Acknowledgment

Katharine O'Moore-Klopf, ELS, of KOK Edit provided editorial assistance.

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Stones of Various Shapes and Colors

Moreover I have taken out innumerable stones with my own hands, with various colors found in the kidneys, in the lungs, in the liver, in the portal vein … Also in the gallbladder … I found stones of various shapes and of various colors and very many in some others.

— De re Anatomica Libri, Matteo Realdo Colombo, 1516-1559, Italian Professor of Anatomy and Surgeon at the University of Padua, Italy