

**PHYSIOLOGICAL AND PATHOLOGICAL CONSIDERATIONS  
ON THE GALL BLADDER**

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**Keywords:** *Gallbladder, pathology, gallstone*

**ABSTRACT**

*This paper examines the physiological and pathological aspects of the gallbladder, with a particular focus on original research concerning the pathology of gallstones. A comprehensive understanding of the mechanisms underlying gallbladder disease requires an in-depth analysis of its anatomical structure and physiological functions. Furthermore, the study addresses predisposing factors, genetic determinants, and lifestyle influences, which are integral to the pathogenesis of gallbladder disorders and provide a basis for their prevention and management. The research also evaluates various surgical interventions for the treatment of prevalent gallbladder pathologies, comparing their efficacy in a specific patient cohort. Emphasis is placed on the gallbladder's critical role in the digestive process, as it contributes to the integrated functioning of the body's organs.*

**INTRODUCTION**

Gallstones primarily consist of cholesterol, bilirubin, and calcium salts, with smaller amounts of proteins and other materials. They are classified into three types: cholesterol stones (at least 90% cholesterol), pigment stones (predominantly bilirubin), and mixed stones, which include cholesterol, bilirubin, and calcium compounds. In Western populations and Pakistan, over 70% of gallstones are cholesterol-based. Cholesterol stones form when bile becomes supersaturated with cholesterol, exceeding bile's ability to solubilize it, leading to crystal formation. Cholesterol gallstone formation is closely linked to cholesterol supersaturation, often due to increased cholesterol synthesis, impaired bile acid conversion, or reduced bile salt secretion. (Duane 1990)

Pigment stones, on the other hand, form from excessive bilirubin, often seen in conditions like cirrhosis or chronic hemolysis. Brown pigment stones, commonly found in bile ducts, are linked to bacterial infection, while black pigment stones are associated with cirrhosis and hemolytic disorders. Risk factors for gallstone formation include elevated biliary protein, lipid concentrations, and gallbladder motility impairment, which slows the clearance of cholesterol crystals. Additional contributing factors include genetic predisposition, obesity, insulin resistance, and metabolic syndrome. (Channa et al. 2008)

Conditions such as pregnancy, fasting, rapid weight loss, and ceftriaxone use can lead to the formation of gallbladder sludge, a precursor to gallstones. Increased biliary calcium also contributes to pigment stone calcification, which hardens the stones and makes them more likely to cause symptoms. (Trotman et al. 1975)

Intestinal motility also plays a critical role in cholesterol lithogenesis, as sluggish intestinal movement can lead to increased bile cholesterol saturation. Dietary factors, such as low fiber intake, have been implicated in the formation of gallstones, while a fiber-rich diet may reduce the risk by accelerating intestinal transit and lowering bile cholesterol saturation. Hormonal influences, particularly from estrogen, can also increase the risk of cholesterol gallstone formation, as estrogen boosts cholesterol levels in bile, making women more susceptible, particularly during pregnancy or hormone replacement therapy. (Hayes et al. 1992)

Epidemiological research demonstrates significant variation in the prevalence of cholelithiasis across different populations. Gallstone disease is particularly prevalent in industrialized nations, where environmental factors such as diets high in fat and low in dietary fiber, combined with sedentary lifestyles, are common. Conversely, its incidence is lower in developing populations that maintain traditional diets characterized by high fiber and low fat intake. The prevalence is notably elevated in Scandinavian countries, Chile, and Native American populations, likely due to a combination of genetic susceptibility and dietary patterns. Cholelithiasis is also more prevalent in regions such as North America, Europe, and Australia, where Westernized diets and lifestyle factors predominate. In contrast, its occurrence is significantly lower in Africa, India, China, Japan, Kashmir, and Egypt, which may be attributed to variations in diet, genetic factors, and reduced obesity rates. Moreover, the risk of gallstone formation increases with advancing age, and females exhibit a higher predisposition, likely due to hormonal factors such as estrogen, further contributing to the observed disparities in gallstone prevalence across populations. (Bouchier 1977)

Several predisposing factors increase the risk of gallstone formation. These include genetic predisposition, obesity, rapid weight loss, and diets high in cholesterol and low in fiber. Hormonal factors also play a role, with women at higher risk due to estrogen, which increases cholesterol secretion in bile. Other risk factors include age, certain medical conditions like cirrhosis and hemolytic anemias, and certain medications. (Vázquez et al. 2012)

The clinical presentation of gallstones varies; many individuals are asymptomatic and remain undiagnosed. However, when symptoms do occur, they typically manifest as biliary colic, characterized by sudden and intense pain in the upper right abdomen, often radiating to the back or right shoulder. Other symptoms may include nausea, vomiting, and, in cases of complicated gallstone disease, jaundice, fever, and severe abdominal pain indicative of cholecystitis or pancreatitis. (Singhal et al. 2006)

Treatment of gallstones depends on the severity and type of symptoms. Asymptomatic gallstones generally do not require treatment. In symptomatic cases, the standard treatment is cholecystectomy, the surgical removal of the gallbladder, which can be performed laparoscopically or, less commonly, through open surgery. In some cases, non-surgical options such as oral bile acid pills (ursodeoxycholic acid) or lithotripsy (shock wave therapy) may be considered, particularly in patients who are not surgical candidates. Additionally, lifestyle modifications, including

maintaining a healthy weight, consuming a balanced diet low in saturated fats, and regular physical activity, can help reduce the risk of gallstone formation and recurrence. (Jones et al. 2024)

In many instances, accurately diagnosing and determining the optimal treatment strategy for common bile duct stones relies heavily on the patient's condition and the expertise of the medical team. The specialized literature lacks a universal standard for the diagnosis and management of this condition. Diagnosing common bile duct stones is a subject of considerable debate, with ethical and socio-economic factors significantly influencing decisions. Additionally, advanced diagnostic and treatment techniques may be inaccessible to many patients and clinics. Given these challenges, this study aims to: identify predictive signs and symptoms for common bile duct stones; evaluate and prioritize diagnostic methods; assess and rank treatment approaches, and analyze the advantages and disadvantages of various treatment options for this condition. (Lee et al. 2015)

Asymptomatic cholelithiasis generally does not warrant cholecystectomy. Ursodeoxycholic acid therapy is recommended for symptomatic patients with small cholesterol stones or gallbladder sludge. Patients should be informed about the option of curative cholecystectomy. Extracorporeal shock-wave lithotripsy (ESWL) is not advised for cholelithiasis. Cholecystectomy remains the first-line treatment for symptomatic cholelithiasis and gallbladder sludge causing biliary pain. Biliary colic is managed with nonsteroidal anti-inflammatory drugs, with spasmolytics, nitroglycerin, or opioids used for severe cases.

For concomitant cholelithiasis and choledocholithiasis, endoscopic bile duct stone removal should precede cholecystectomy, ideally within 72 hours, reducing biliary event recurrence by 90%. Gallbladders without stones can be left intact. The European Association for the Study of the Liver (EASL) and the Society of American Gastrointestinal and Endoscopic Surgeons (SAGES) recommend the four-trocar technique for laparoscopic cholecystectomy, with alternative approaches reserved for experienced surgeons. Large gallbladder stones (>3 cm), polyps (>1 cm), and porcelain gallbladder, associated with higher malignancy risk, necessitate elective cholecystectomy even in asymptomatic cases.

In bariatric surgery, simultaneous cholecystectomy is reserved for patients with known gallstones or those undergoing major malabsorptive procedures. Acute cholecystitis, the most frequent complication of gallstones, should be treated with early cholecystectomy within 24 hours of diagnosis to prevent complications such as choledocholithiasis or biliary pancreatitis. Laparoscopic cholecystectomy has become the standard for acute cholecystitis due to its reduced hospital stay and complication rates. (Gutt et al. 2020)

## **MATERIAL AND METHODS**

The material for this study consists of a retrospective analysis of 47 patients (26 female and 21 male) admitted with suspected common bile duct stones. These patients were diagnosed and treated at the Surgery Clinic of the Emergency Clinical Hospital Craiova over a four-year period, from January 1, 2015, to December 31, 2019. Inclusion criteria focused on patients for whom comprehensive data were available, encompassing patient identification details, reasons for admission, initial diagnosis, clinical examination findings, biological test results, imaging findings, and the selected treatment approach—whether conservative or surgical. The study also examined the type of surgical intervention performed, distinguishing between

laparoscopic and open procedures, and assessed intraoperative macroscopic findings. Patients who refused the recommended therapeutic intervention were excluded from the study to ensure the reliability of the analysis. The methodological approach includes a thorough evaluation of diagnostic procedures, such as the reasons for admission, clinical evaluations, laboratory tests, and imaging studies. Additionally, the study delves into the treatment strategies applied in managing common bile duct stones, aiming to identify patterns and outcomes that could inform future clinical practices.

## RESULTS AND DISCUSSIONS

The distribution of patients according by gender shows that out of a total of 47 cases, 26 are female and 21 are male. The age of the patients in the study group ranges from 20 to 87 years. The analysis of the distribution by age decades indicates an increase in the prevalence of main bile duct lithiasis with advancing age, with a higher frequency of the condition observed in patients in the seventh and eighth decades of life. In terms of age and gender distribution, it is noted that the majority of female patients (7 cases) fall within the age range between 40 - 50 years and between 70 - 80 years (7 cases), with a secondary range between 60 - 70 years (6 cases). Regarding male patients, they are predominantly in the range between 60 - 70 years (6 cases), followed by the age groups of 70 - 80 years (5 cases) and 80 - 90 years (5 cases) (Figure 1).

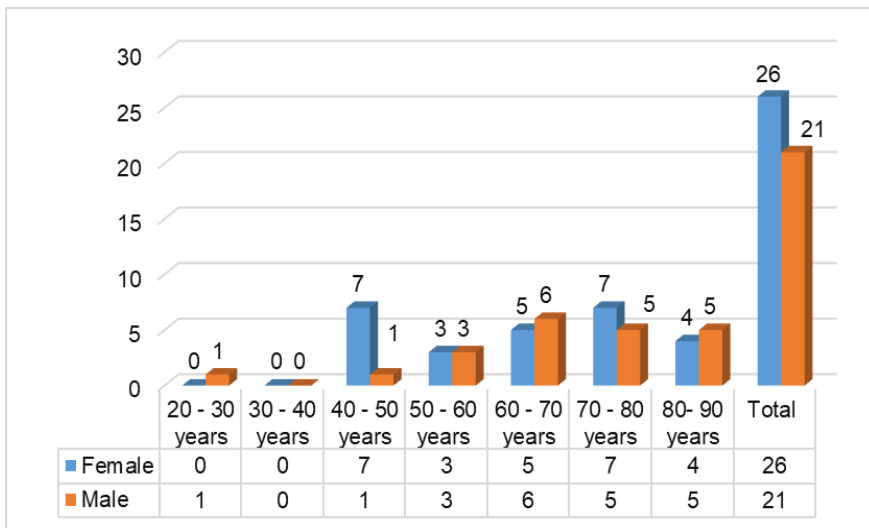


Figure 1. Distribution of patients according to age group and gender

The signs and symptoms of gallbladder stones exhibit a wide range of clinical manifestations, from the absence of symptoms to severe complications. Among the most common symptoms of this condition are: pain, in the right side of the upper abdomen in 39 cases, nausea, presented in 32 cases, vomiting, in 25 cases, fever, in 30 cases, while yellow coloring of the skin and eyeballs (jaundice) were reported in 20 cases (Figure 2).

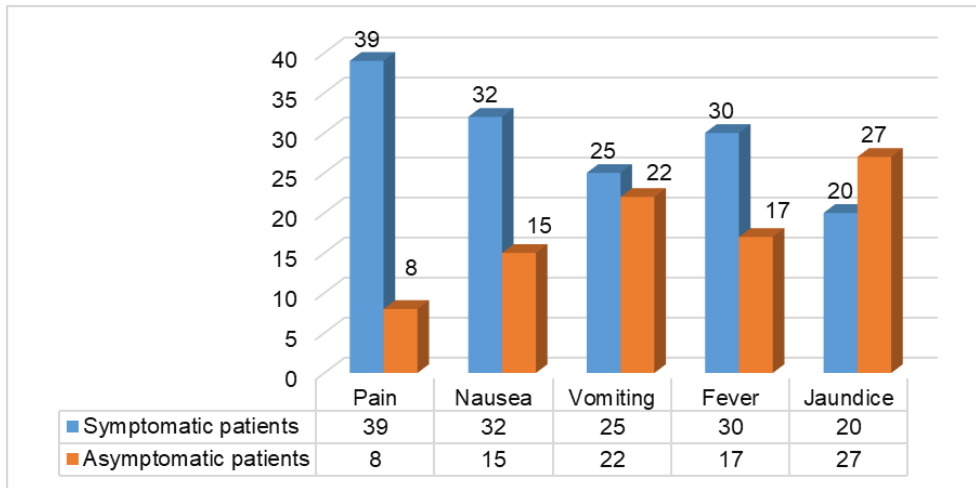


Figure 2. Distribution of patients according to the presence of symptoms suggestive of main bile duct lithiasis

In the study, several paraclinical examinations were performed on the patients, including abdominal X-ray (5 patients), abdominal ultrasound (47 patients), computed tomography – CT (8 patients), and cholangiography (14 patients) (Figure 3).

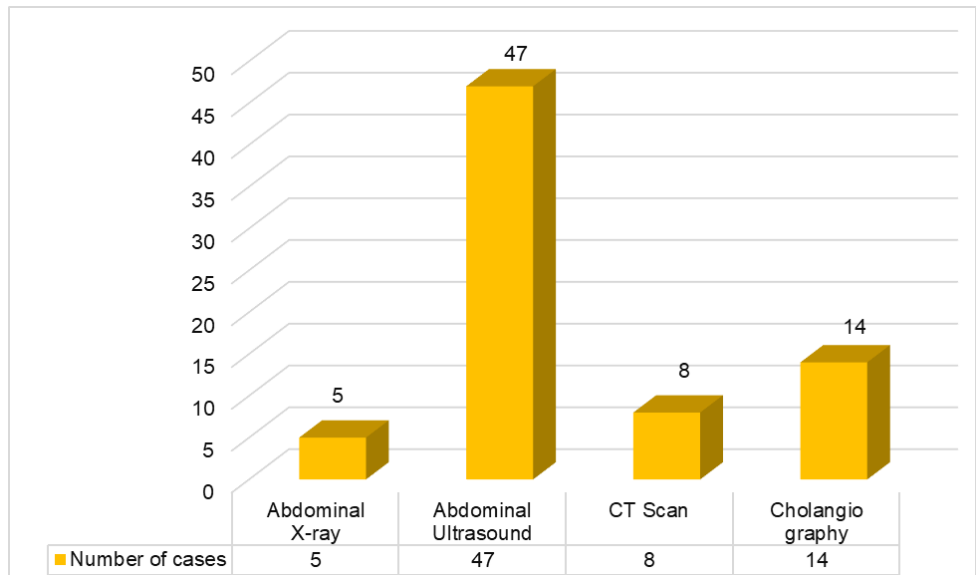


Figure 3. Paraclinical examinations performed

Out of the 47 patients included in the study, 46 underwent surgical interventions, while one case was treated conservatively. Various surgical procedures were used to treat main bile duct lithiasis, including cholecystectomy (43 patients), choledocholithotomy (21 patients), choledochoscopy (6 patients), endoscopic retrograde cholangiopancreatography (ERCP) (11 patients), and

biliodigestive derivations, with or without external biliary drainage (17 patients). The surgical approach was performed both traditionally and laparoscopically (Figure 4).

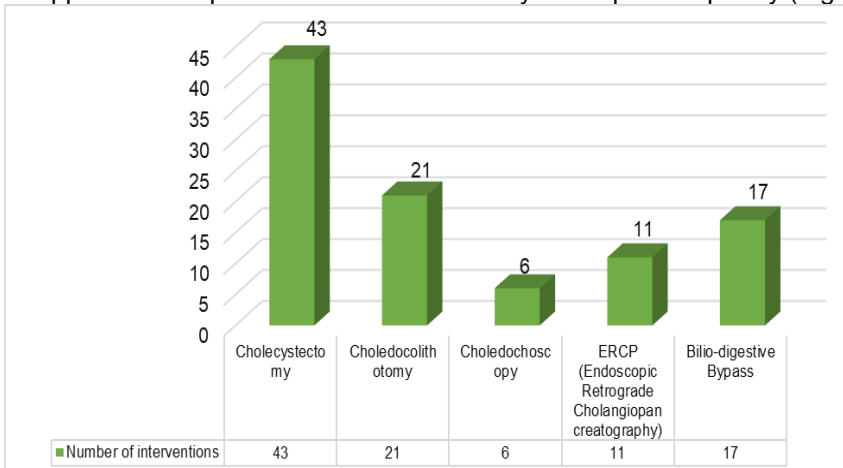


Figure 4. Surgical procedures performed for the treatment of main bile duct lithiasis

During surgery, macroscopic changes were observed in the main bile ducts and surrounding organs, providing relevant details about the cause of the main bile duct obstruction, the stage of disease progression or associated complications (Figure 5).

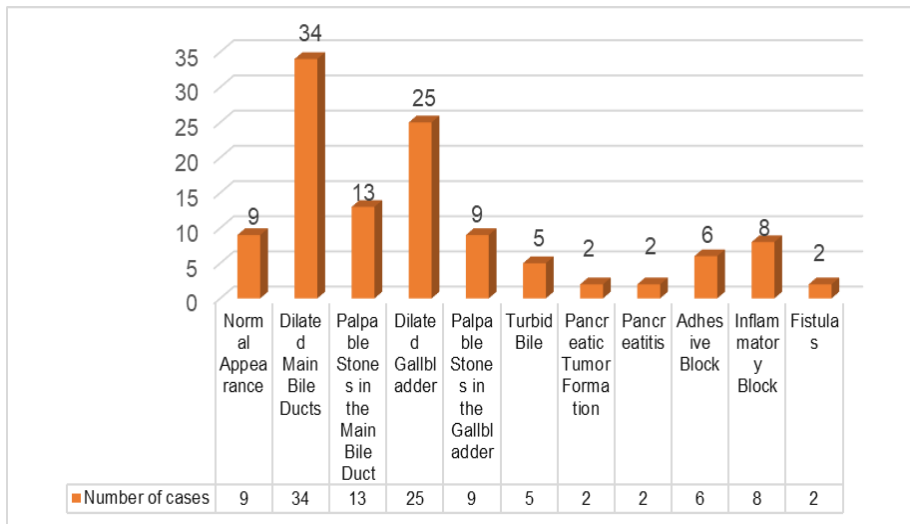


Figure 5. Intraoperative findings

External biliary drainage was essential in 23 cases, while the remaining 24 cases did not require external biliary drainage. Among the 23 cases, Kehr drainage was applied in 5 cases, while transcystic drainage was used in 18 cases (Figure 6).

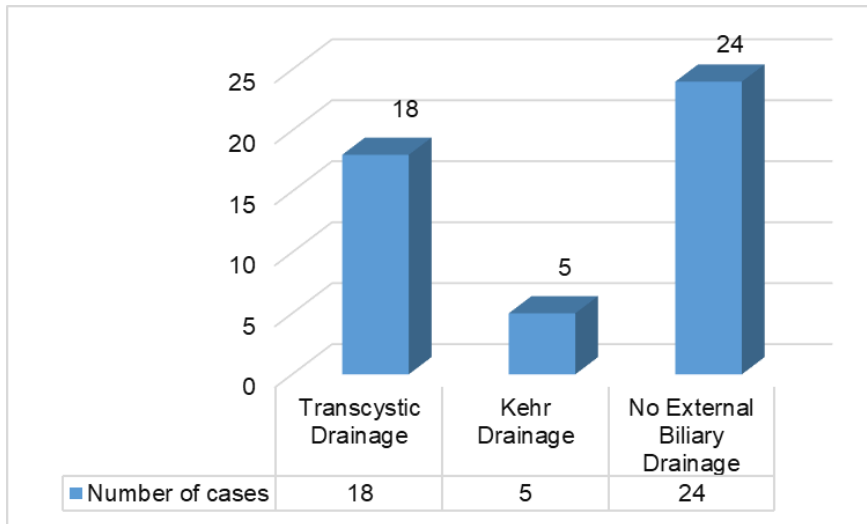


Figure 6. Distribution of patients based to the use of external biliary drainage and its type

Regarding the surgical method, both traditional and laparoscopic approaches were used. Thus, while in 11 cases the laparoscopic approach was attempted, in 35 cases, the surgical resolution was attempted through the classic approach (Figure 7).

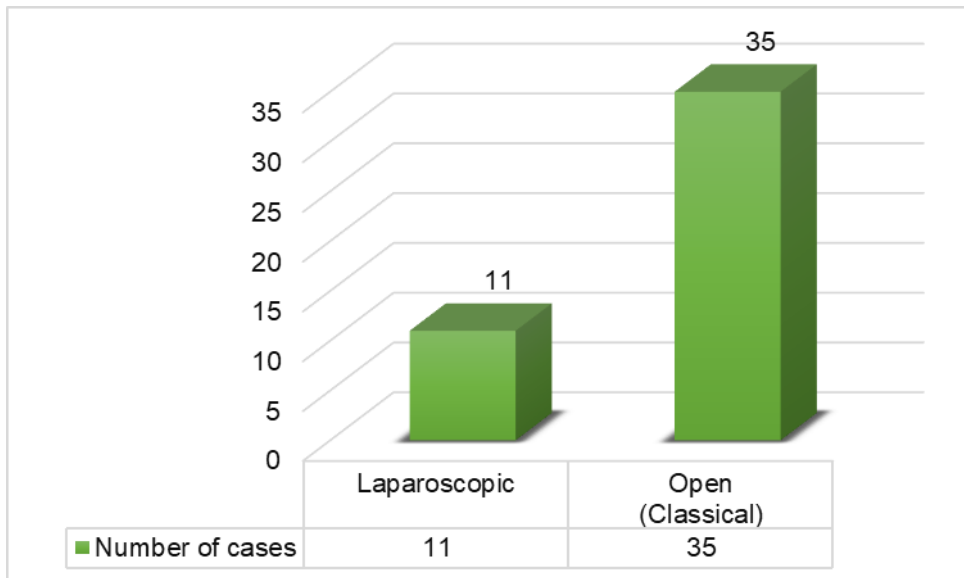


Figure 7. Distribution of patients according to the surgical approach (laparoscopic or classic)

## CONCLUSIONS

Main bile duct lithiasis presents significant challenges in both diagnostic and therapeutic contexts. This condition predominantly affects individuals over the age of 60 and shows a higher prevalence in females. Clinically, it is characterized by symptoms including right hypochondriac pain, nausea, fever, jaundice, and vomiting. Diagnostic evaluation typically involves magnetic resonance cholangiography (MRC), computed tomography (CT), and ultrasonography. For effective treatment, choledochoscopy and the "rendez-vous" technique are pivotal. Endoscopic sphincterotomy, often combined with early cholecystectomy, has emerged as the gold standard for managing elderly patients with significant risks or comorbidities. Additionally, endoscopic sonography and magnetic resonance cholangiopancreatography (MRCP) are crucial for precise diagnosis and tailored management of gallstones. The integration of conventional and advanced diagnostic methods, along with ongoing surgical team training, is essential for ensuring optimal care and maintaining high standards in the management of biliary disorders.

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