JOURNAL OF CLINICAL AND BIOMEDICAL SCIENCES

ORIGINAL ARTICLE

OPEN ACCESS

Received: 18-08-2025
Accepted: 14-11-2025
Published: 15-06-2026

Citation: Swathy S, Deepak L, Swathi R, Ramesh P K, Sathi P P. Morphological Spectrum of Gall Stone Disease - A Tertiary Care Centre Experience. 2026; 16(2):41-46. https://doi.org/10.58739/jcbs/v16i2.25.326

* **Corresponding author.**
swathyshanker.ss@gmail.com

Published By Sri Devaraj Urs Academy of Higher Education, Kolar, Karnataka

ISSN
Print: 2231-4180
Electronic: 2319-2453

Morphological Spectrum of Gall Stone Disease - A Tertiary Care Centre Experience

Swathy Shanker[1*], Deepak Lavatt[2], Swathi Raj[3], Ramesh P K [4], Sathi P P [5]

1 Assistant Professor, Department of PG studies and Research, KMCT Medical College, Kerala, India.
2 Assistant Professor, Department of Surgery, KMCT Medical College, Kerala, India.
3 Senior Resident, Department of Pathology, KMCT Medical College, Kerala, India.
4 Professor, Department of Surgery, KMCT Medical College, Kerala, India.
5 Professor, Department of Pathology, KMCT Medical College, Kerala, India.

Abstract

Context: Gallstones are a recurrent hepatobiliary disease seen in around 10-15% of the population. Various classification systems have been proposed for the classification of gall stones, and the widely used system utilizes the morphology and chemical content of gall stones. **Aims:** In this study we aim to evaluate the incidence of gall stones and to describe the clinicopathological correlation of the disease in the study population. **Settings and Design:** This is a retrospective, descriptive study done using the medical records of patients presented with cholelithiasis over a period of 2 years. **Methods and Material:** A total of 155 patients were included in the study. The histopathological diagnoses of the cholecystectomy specimens were retrieved from the archived reports, and the data was evaluated with patient details. **Statistical analysis used:** Data was entered in Microsoft Excel and analysed for correlation between various variables using SPSS software version 22.0. **Results:** The ages of the patients varied from 15 years old to 85 years old, with the mean age of the study population being 47 years. A female predominance was seen, and pigment stones were found to be the most common type. Majority of the patients (58.7%) had no coexisting comorbidities while the most common comorbidity seen in patients with pigmented stones was that of diabetes (13.3%). Among the patients with cholesterol stones 15.4% of the patients showed presence of thyroid disorder and two out of the three patients with mixed type of gall stones showed coexisting diabetes. **Conclusions:** Gall stones were found more commonly among women with an increased incidence in women of the reproductive age group. The most common gall stone found in the study population was that of pigment stones followed by cholesterol stones. Patients with diabetes showed an increased incidence of pigmented and mixed stones while patients with thyroid disorder showed an increased incidence of cholesterol stones. **Key Messages:** An increased incidence of pigmented and mixed gall stones has been observed among patients with diabetes. A larger, population based study is warranted to evaluate the underlying mechanism.

Keywords: Cholelithiasis, Pigment stones, Cholesterol stones

1 Introduction

Gall stones (cholelithiasis) are a prevalent disease in developed nations, while it is less prevalent in developing nations. This implies a correlation between the diet followed by individuals and the occurrence of gall stones[1]. Studies have shown that the prevalence of gall stones is estimated to be around 10- 15%[2-4].

Gall stone disease is a chronic and often recurrent hepatobiliary disease. The pathophysiology of the disease has been linked to the impaired metabolism of bilirubin, calcium

salts, cholesterol and other materials which leads to accumulation of the same[5, 6]. The presence of gall stones in the biliary tract may sometimes be an incidental finding, posing no significant health issues or symptoms in the patients. More often, these patients present with symptoms of abdominal pain and vomiting[7].

When the substances in the bile exceed in their solubility, the bile becomes supersaturated and it becomes harder for the sludge to move through the biliary system. This leads to precipitation of substances forming stones that vary in size. The stones can migrate into the biliary tract causing cholangitis and pancreatitis[8].

Several classification systems have been proposed depending on the etiology, composition, morphology and anatomical location. The most commonly used classification system that was proposed in 1981 at the national institute of health-international workshop, classifies gall stones into cholesterol stones and pigment stones, with pigment stones further subclassified into brown or black[9]. In 1986 another classification system was proposed which divided gall stones into cholesterol, pigment and rare subtypes. Cholesterol stones were further classified into pure, mixed and combination stones while pigmented stones were classified further into black and calcium bilirubinate stones[10].

Gall stones are of 3 major types including pigment stones, cholesterol stones and mixed stones

Pigment stones contain bilirubin while cholesterol stones contain cholesterol. Mixed stones may contain both cholesterol and bilirubin along with calcium salts including calcium carbonate and calcium phosphate[11]. Studies have shown that increasing age and presence of obesity shows an increase in incidence of gall stones[12, 13]. Diabetic patients have an increased level of triglycerides which poses an increased risk of occurrence of gall stones[14].

In this study we aim to evaluate the incidence of different types of gall stones in the population and to assess the correlation between age, along with coexisting comorbidities and the type of gall stones seen in the patients.

2 Materials and Methods

This was a retrospective institutional study done by evaluating the patients that presented to the Department of Surgery with features and USG (ultrasonography) findings of cholelithiasis. Patients without USG findings of cholelithiasis were not included in the study. A total of 155 patients were included in the study.

The cholecystectomy specimens were sent to the Department of Pathology for histopathological diagnosis. The histopathological diagnoses were retrieved from the medical records and tabulated against the patient details. The data entered in Microsoft Excel was analysed and an assessment of possible correlation between various variables were done. The analysis was done using SPSS software version 22.0.

3 Results

A total of 155 patients were included in the study. The ages of the patients varied greatly with the youngest patient being 15 years old and the oldest patient being 85 years old. The mean age of the study population was seen to be 47 years with a standard deviation of 16 years. Majority of patients were seen between the ages of 32 to 58 years. Fig. 1 shows the age distribution of the study population. Spearman correlation coefficient of 0.137 was obtained showing a weak positive correlation.

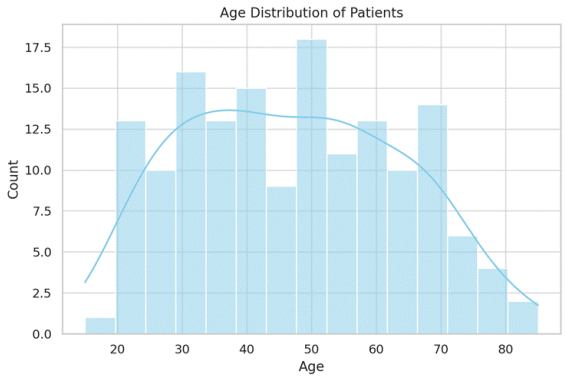

Fig. 1: Age distribution of the study population

The study population showed a predominance of females with 105 females constituting 67.74% of the study population while males constituted 32.26% of the study population. An analysis of the sex of the patients against age of the patients showed that males have a higher average age of 56.12 years when compared to females who had an average age of 42.85 years (Fig. 2).

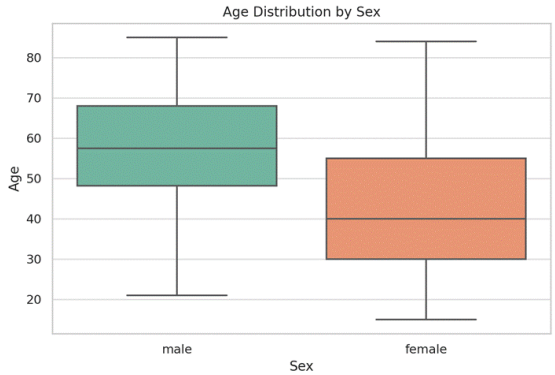

Fig. 2: Age distribution among males and females of the study population

The cholecystectomy specimens received were cut and processed for analysis and majority of the specimens showed presence of gall stones of pigmented type (Table. 1). The analysis reveals that pigmented stones are the most common type, significantly outnumbering cholesterol and mixed stones. Cholesterol stones occur less frequently than pigmented stones but are still more common than mixed stones.

Table 1: Type of gall stones seen in the study population

Colour of stones	Count (n)
Pigmented	120
Cholesterol	26
Mixed	3
None	6
Total	**155**

The study showed that six out of 155 patients showed no gall stones in the cholecystectomy specimens received although ultrasonographic findings showed possible presence of gall stones. Histopathological diagnosis of these six patients showed the features of cholecystitis with cholesterolosis, xanthomatous inflammation and papillary hyperplasia. The histopathological diagnoses of the study population is given in Table. 2. Majority of the patients showed histopathological features of calculous cholecystitis (91.6%).

Table 2: Histopathological diagnoses of the study population

Histopathological diagnosis	Count (N)
Calculous cholecystitis	142
Calculous cholecystitis with empyema formation	3
Calculous cholecystitis with cholesterolosis	3
Follicular and calculous cholecystitis	1
Cholecystitis with cholesterolosis	3
Cholecystitis with xanthomatous inflammation	2
Cholecystitis with papillary hyperplasia	1

Medical records of the patients in the study population were retrieved and analysed for the presence of co-existing comorbidities. Majority of the patients (58.7%) showed no co-existing comorbidities while others showed diabetes, hypertension and thyroid disorders (Table. 3).

Few patients had co-existing diabetes and hypertension while very few had co-existing diabetes with thyroid disorders. The most common ailment found in the study population was that of diabetes, constituting 26.45 % of the study population and constituting 64.1% of all the comorbidities seen in the study population. Out of 155 patients, 21 patients had diabetes while 15 had both hypertension and diabetes. A total of 13 patients had hypertension, ten had thyroid disorders and five had coexisting thyroid disorder and diabetes.

Table 3: Presence of comorbidities in the subtypes of gall stones studied

Type of stones	Coexisting comorbidities	Count (N)
Pigmented	None	72
Pigmented	Diabetes	16
Pigmented	Diabetes with hypertension	13
Pigmented	Hypertension	11
Pigmented	Thyroid disorder	6
Pigmented	Thyroid disorder and diabetes	2
Cholesterol	None	12
Cholesterol	Thyroid disorder	4
Cholesterol	Diabetes	3
Cholesterol	Thyroid disorder and diabetes	3
Cholesterol	Diabetes with hypertension	2
Cholesterol	Hypertension	2
Mixed	Diabetes	2
Mixed	None	1
Total	149	

An analysis of the presence of the coexisting ailment and the type of gall stone seen was done and showed the following results (Table. 3). Majority of patients with pigment stones had no coexisting comorbidities (60%), while hypertension was seen in 9.2% of patients with pigmented gall stones and diabetes in 13.3% of the patients. Only 5% of patients with pigmented gall stones had thyroid disorders. About 10.8% of patients with pigmented gall stones had both diabetes and hypertension while 1.7% of patients had thyroid disorder and diabetes.

Among the 26 patients that showed presence of cholesterol stones, 46.2% had no coexisting comorbidities. About 15.4% showed presence of thyroid disorder and 11.5% showed presence of diabetes with similar number of patients showing thyroid disorder with diabetes too (11.5%). About 7.7% of patients showed diabetes and similar number showed diabetes with hypertension too.

Out of the three patients with mixed type of gall stones, two patients showed coexisting diabetes while one had no coexisting comorbidities. Based on the analysis, diabetes exhibits the strongest correlation with mixed stones, although the count is only two. The other two stone types, cholesterol and pigmented, are more strongly correlated with the absence of the specified comorbidities.

A heat map was generated correlating the presence of comorbidities with the type of gall stone seen in the specimens received (Fig. 3). The heatmap displays correlation coefficients between each pair of Type of stones and Coexisting comorbidities. The color intensity in the heatmap corresponds to the strength and direction of the correlation, with darker shades indicating higher positive correlations and lighter shades indicating lower correlations Pigmented stones with no comorbidities have a significantly larger count (69) compared to mixed stones with no comorbidities.

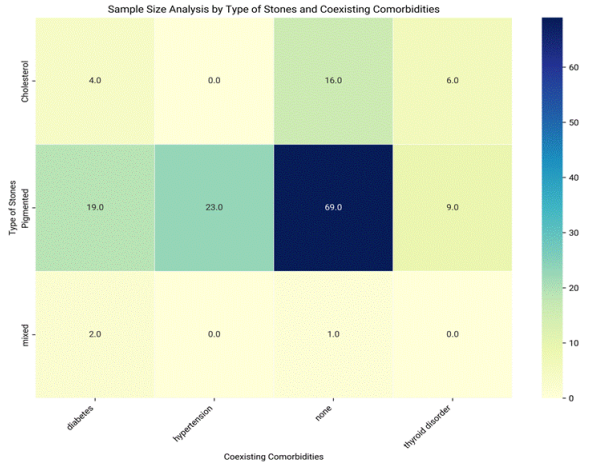

Fig. 3: Heatmap showing correlation between comorbidities and type of gall stones

3 Discussion

The present study shows a predominance of female population. Similar findings were shown in different studies showing the positive correlation of sex with occurrence of the disease[15-17]. A systematic review done in 2024 also showed a female predominance[18].

The age group in which the women are found to be diagnosed with gall stones are lower than in men, showing that there is an increased occurrence of gall stones in women in their reproductive ages and the occurrence decreases after menopause. Estrogen hormones have been noted to play an important role in development of gall stone disease with an increase in number of patients who are on hormone therapy or on oral contraceptives. This may be attributed to the increased cholesterol levels in bile and decreased biliary movement[19, 20]. Men on the other hand show an increased occurrence of gall stones in an older age. Study conducted by Qiao *et al.* showed that cholesterol stones were more frequent in women in the age group of 30-50 years[21]. Our study also showed an increase in number of gall stones in women in the same age group.

Majority of patients were found to be in the age group of 32 to 58 years. A study conducted by Veerabhadrappa et al in India showed that majority of cases was in the age group of 41 to 60 years of age, similar to our study[17]. A contradictory finding was shown by Maskey *et al.* that showed the predominant patient population to be less than 30 years[22]. In our study we saw a weak positive correlation with age. This may be due to the increase in deoxycholic acid levels in bile and a decrease in activity of cholesterol 7α hydroxylase, thereby increasing cholesterol saturation in bile[23, 24].

Traditional classification systems have classified gall stones as cholesterol stones and pigment stones. Cholesterol stones are typically grey white to yellow in color with a cholesterol content of ≥70% while pigment stones contain cholesterol ≤30% and are typically black in colour. Pigment stones have a cholesterol content varying from 30-70%. Previous classification systems have utilized the structure of the stone, the site of occurrence of stone and etiology of the disease[10]. With development of newer technologies like infrared spectroscopy a more detailed insight into the composition of the stones have been obtained and this has led to the currently popular classification into cholesterol stones, pigment stones, mixed stones and other rare stones including those with calcium carbonate, calcium phosphate etc.[25, 26]

A study conducted in 2013 utilised infrared spectroscopy in classification of gall stones and showed that stones with cholesterol content of less than 30% included pigment stones along with other stones such as calcium carbonate stones, calcium phosphate stones, cystine stones, protein stones and even stones containing bilirubinate-calcium carbonate, bilirubinate-phosphate etc.[21]

In our study there was a predominance of pigmented stones in the study population. This is in concordance with a similar study done in India which showed a predominance of pigment stones[17].

Another study done in India showed a predominance of mixed stones followed by pigment stones, which was confirmed by chemical analysis. The same study has noted that cholesterol stones are soft and smooth while pigment stones are soft and rough in the outer surface. Mixed calculi showed smooth and rough surface. Spokes of wheel appearance with a nuclear cross-section was seen in cholesterol calculi, while pigment stones appeared amorphous, and mixed stones had laminations. Pigment stones had highest total bilirubin, bile acids, soluble protein, sodium, potassium, calcium , magnesium and chloride content as compared to cholesterol and mixed stones, while total cholesterol, fatty acids, phospholipids, copper and inorganic phosphate was highest in cholesterol stones and triglycerides iron and oxalate were highest in mixed stones[27].

Studies have shown a higher risk of gall stone occurrence in patients with diabetes, hypertension, hyperlipidemia and cardiovascular diseases[28]. It has been shown that pigmented (black) gallstones vary considerable in terms of composition and relative cholesterol content. Two types of black stones, one with significantly higher bilirubin content that the other has been described by Kleiner O *et al.*[29]

About 60-70% of the Indian population with gall bladder malignancy has shown presence of gall stones. Patients with gall stones have been reported to have a higher risk of developing gall bladder malignancy[30]. A study showed that among Asians Indians have the highest percentage of occurrence of gall stones ,constituting 10-22% of the population[31].

The diagnostic modality commonly used for gall stones include ultrasonography and Computed tomography along with extensive history taking and clinical examination. Laparoscopic cholecystectomy remains the optimal treatment option for cholelithiasis. When laparoscopic procedure is not feasible, open cholecystectomy procedure is done[32]. The last few years have shown an advancement in the field of medicine with discovery of newer biomarkers and remedies including shock wave therapy and even conventional herbal therapies, especially Chinese medicine. The clinical acceptability of such therapies are yet to be studied.

4 Conclusion

Gall stones are found more commonly in women with an increase in incidence in the reproductive age group. The most common type of gall stone found in the study population was that of pigment stones followed by cholesterol stones. The most common histopathological diagnosis was that of chronic cholecystitis. Patients with coexisting diabetes showed an increased incidence of pigmented stones and mixed stones while patients with coexisting thyroid disorder showed an increased incidence of cholesterol stones.

5 Disclosure

Ethical consideration:

There were no ethical considerations to be considered in this research as no additional investigations were done for the patients.

Funding:

This research did not receive any grant from funding agencies in the public, commercial, or non-profit sectors.

Author's contributions:

The authors equally contributed to preparing this article.

Conflicts of interest:

There are no conflicts of interest

References

1. Schwesinger WH, Kurtin WE, Page CP, Stewart RM, Johnson R. Soluble dietary fiber protects against cholesterol gallstone formation. *The American Journal of Surgery*. 1999;177(4):307-310. Available from: 10.1016/s0002-9610(99)00047-1
2. Brett M, Barker DJP. The World Distribution of Gallstones. *International Journal of Epidemiology*. 1976;5(4):335-341. Available from: 10.1093/ije/5.4.335
3. Shabanzadeh DM. Incidence of gallstone disease and complications. *Current Opinion in Gastroenterology*. 2018;34(2):81-89. Available from: 10.1097/mog.0000000000000418
4. Stinton LM, Shaffer EA. Epidemiology of Gallbladder Disease: Cholelithiasis and Cancer. *Gut and Liver*. 2012;6(2):172-187. Available from: 10.5009/gnl.2012.6.2.172
5. Schirmer BD, Winters KL, Edlich RF. Cholelithiasis and Cholecystitis. *Journal of Long-Term Effects of Medical Implants*. 2005;15(3):329-338. Available from: 10.1615/jlongtermeffmedimplants.v15.i3.90
6. Duane WC. Pathogenesis of Gallstones: Implications for Management. *Hospital Practice*. 1990;25(3):65-80. Available from: 10.1080/21548331.1990.11703924
7. Rigas B, Torosis J, McDougall CJ, Vener KJ, Spiro HM. The Circadian Rhythm of Biliary Colic. *Journal of Clinical Gastroenterology*. 1990;12(4):409-414. Available from: 10.1097/00004836-199008000-00011
8. Shabanzadeh DM. New determinants for gallstone disease?. *Danish Medical Journal*. 2018;65(2):B5438. Available from: https://pubmed.ncbi.nlm.nih.gov/29393043/
9. Trotman BW, Soloway RD. Pigment Gallstone Disease: Summary of the National Institutes of Health—International Workshop. *Hepatology*. 1982;2(6):879-884. Available from: 10.1002/hep.1840020624
10. Suzuki N, Sato T. A new classification of gallstone. *Journal of Biliary Tract and Pancreas* 1986;7:1467-70.
11. Channa NA. Gallstone disease: a review. *Pakistan Armed Forces Medical Journal*. 2008 Jun 30;58(2):197-208.
12. Shaffer EA. Gallstone disease: Epidemiology of gallbladder stone disease. *Best Practice & Research Clinical Gastroenterology*. 2006;20(6):981-996. Available from: 10.1016/j.bpg.2006.05.004
13. Trotman BW, Petrella EJ, Soloway RD, Sanchez HM, Morris TA, Miller WT. Evaluation of Radiographic Lucency or Opaqueness of Gallstones as a Means of Identifying Cholesterol or Pigment Stones. *Gastroenterology*. 1975;68(6):1563-1566. Available from: 10.1016/s0016-5085(75)80145-4
14. Kurtin WE, Schwesinger WH, Diehl AK. Age-related changes in the chemical composition of gallstones. *International Journal of Surgical Investigation*. 2000;2:299–307.
15. Sharma MA. Towards a safer cholecystectomy-The fundus to porta approach.*Indian Journal of Surgery*.1997;59(4):141-5.
16. Selvi TR, Sinha P, Subramaniam PM, Konapur PG, Prabha CV. A clinicopathological study of cholecystitis with special reference to analysis of cholelithiasis. *International Journal Of Basic Medical Science*. 2011;2(2):68-72.
17. Veerabhadrappa PS, Tank P, Singh A, Goel S, Nathwani P. A study of gall stone disease from a tertiary care center of Madhya Pradesh, India. *International Surgery Journal*. 2017;4(2):728-731. Available from: 10.18203/2349-2902.isj20170222
18. Wang X, Yu W, Jiang G, Li H, Li S, Xie L, *et al*. Global Epidemiology of Gallstones in the 21st Century: A Systematic Review and Meta-Analysis. *Clinical Gastroenterology and Hepatology*. 2024;22(8):1586-1595. Available from: 10.1016/j.cgh.2024.01.051
19. Valdivieso V, Covarrubias C, Siegel F, Cruz F. Pregnancy and Cholelithiasis: Pathogenesis and Natural Course of Gallstones Diagnosed in Early Puerperium. *Hepatology*. 1993;17(1):1-4. Available from: 10.1002/hep.1840170102

20. Cirillo DJ, Wallace RB, Rodabough RJ, Greenland P, LaCroix AZ, Limacher MC, *et al.* Effect of Estrogen Therapy on Gallbladder Disease. *JAMA*. 2005;293(3):330-339. Available from: 10.1001/jama.293.3.330
21. Qiao T, Ma RH, Luo XB, Yang LQ, Luo ZI, Zheng PM. The Systematic Classification of Gallbladder Stones. *PLoS ONE*. 2013;8(10):e74887. Available from: 10.1371/journal.pone.0074887
22. Maskey CP, Shrestha ML, Sato Y. Gallstone in TUTH. *JIOM*.1990;12:45-54
23. Paumgartner G, Gerok W, Bertolotti M, Bortolotti S, Menozzi D. Ageing and bile acid metabolism: Studies on 7α hydroxylation of cholesterol in humans. In: *Paumgartner G, Gerok W, editors. Trends in Bile Acid Research*. Lancaster: Kluwer Academic Publishers; 1989: 75-78.
24. Einarsson K, Nilsell K, Leijd B, Angelin B. Influence of Age on Secretion of Cholesterol and Synthesis of Bile Acids by the Liver. *New England Journal of Medicine*. 1985;313(5):277-282. Available from: 10.1056/nejm198508013130501
25. Zeng F, Hai H, Jin L. Analysis on Infrared Spectrum of Human Body Gallstone with Comparative Method. *Spectroscopy and Spectral Analysis*. 2001; 21 (3): 314–316.
26. Cao J, Wu K, Wu Z, Na P, Dai X. Qualitative analysis of gallstones from 472 patients with cholelithiasis from Ningxia using Infrared Spectrum. *Journal of Chinese Physician*. 2006; 8 (8): 1111–1113.
27. Chandran P, Kuchhal NK, Garg P, Pundir CS. An extended chemical analysis of gallstone. *Indian Journal of Clinical Biochemistry*. 2007;22(2):145-150. Available from: 10.1007/bf02913334
28. Sun H, Warren J, Yip J, Ji Y, Hao S, Han W, *et al.* Factors Influencing Gallstone Formation: A Review of the Literature. *Biomolecules*. 2022;12(4):550. Available from: 10.3390/biom12040550
29. Kleiner O, Ramesh J, Huleihel M, Cohen B, Kantarovich K, Levi C, *et al.* A comparative study of gallstones from children and adults using FTIR spectroscopy and fluorescence microscopy. *BMC Gastroenterology*. 2002;2(1). Available from: 10.1186/1471-230x-2-3
30. Lowenfels AB, Lindstrom CG, Conway MJ, Hastings PR. Gallstones and risk of gallbladder cancer. *Journal of the National Cancer Institute*. 1985;75(1):77–80.
31. Stinton LM, Shaffer EA. Epidemiology of Gallbladder Disease: Cholelithiasis and Cancer. *Gut and Liver*. 2012;6(2):172-187. Available from: 10.5009/gnl.2012.6.2.172
32. Jones MW, Weir CB, Ghassemzadeh S. *Gallstones (Cholelithiasis)*. In: StatPearls. Treasure Island (FL): StatPearls Publishing; 2025 Jan. PMID: 29083691.