Original Article

Comprehensive Assessment of Calculous Cholecystitis in a Tertiary Care Hospital of Karnataka Region: Demographics, Surgical Outcomes, Histopathological and Biochemical Perspectives for Optimal Management

Mukesh Kakkar[2], Vikas Dagar[1,*], Venkatesan S[3], Sudhanshu Shekhar[1], Ritu Thakur[4]

[1]AIIMS Kalyani, Saguna, Nadia, West Bengal, India

[2]Apollo Hospital Delhi, Delhi, India

[3]Rajarajeswari Medical College and Hospital, Karnataka, India

[4]AIIMS Rishikesh, Rishikesh, Uttarakhand, India

***Correspondence:** vikas.patho@aiimskalyani.edu.in

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Abstract

Background: This study evaluates the clinical profile, surgical outcomes, and histopathological and biochemical characteristics of gallstones in a tertiary care hospital.

Methods: A prospective observational study was conducted on 58 patients diagnosed with calculous cholecystitis over 18 months. Demographic details, clinical symptoms, and surgical outcomes, including intraoperative and postoperative complications, were recorded. Histopathological examination of gallbladders was performed to assess inflammation, metaplasia, and dysplasia. Biochemical analysis classified gallstones based on composition, providing insights into metabolic and dietary influences. Statistical analysis was done by using SPSS 22 and Microsoft excel 2016.

Result: The male-to-female ratio was 1:2 (19 males, 39 females), mostly aged 21–30 years (27.6%). Common symptoms included right hypochondriac pain (84%) and flatulent dyspepsia (86%). Laparoscopic cholecystectomy was done in 62% (6-day stay), and open in remaining 38% (10-day stay). Histology showed chronic cholecystitis in 93%. Gallstones were mainly pigmented (83%), followed by mixed (10%) and cholesterol (7%). Bile culture showed pus cells in 3 cases, Gram-negative bacilli in 1, with no growth after 48 hours.

Conclusion: A multidisciplinary approach integrating clinical assessment, surgical management, histopathology, and biochemical profiling is crucial for better patient outcomes. Understanding demographic trends and stone composition aids in personalized treatment and preventive strategies, reducing recurrence rates and complications. Further studies on metabolic risk factors are recommended.

Keywords: Calculous cholecystitis; Gallstones; Histopathology; Biochemical analysis

Introduction

Calculous cholecystitis is a prevalent hepatobiliary disorder requiring timely surgical intervention, making it a crucial topic for surgeons, particularly in the early phases of their training. Gallbladder diseases form a significant proportion of cases in general surgery, and a thorough understanding of their clinical presentation, surgical management, and histopathological implications is essential for effective patient care. Given the high burden of gallstone disease worldwide, especially in regions with dietary and metabolic predispositions, this topic holds immense importance in surgical education and practice. [1]

Gallstones form due to an imbalance in bile composition, leading to cholesterol, pigmented, or mixed stones, which may result in acute or chronic cholecystitis. The incidence is higher in females and increases with age, obesity, and metabolic disorders such as diabetes mellitus. [2] The gold standard treatment remains cholecystectomy, with laparoscopic cholecystectomy being the preferred approach due to its advantages in reducing postoperative morbidity, hospital stay, and recovery time. [3] However, open cholecystectomy is still required in complex cases, such as those with severe inflammation, adhesions, or suspected malignancy. [4]

Histopathological evaluation of gallbladder specimens plays a crucial role in detecting chronic inflammatory changes, metaplasia, and potential malignant transformation.[5] Additionally, analyzing gallstone composition provides insights into metabolic influences and can guide preventive strategies. [6] Understanding these factors is particularly relevant for early-career surgeons, as calculous cholecystitis constitutes a major portion of cases encountered in general surgery practice. [7]

Despite advancements in surgical techniques and diagnostic modalities, there remains a need for updated research evaluating the clinical, surgical, histopathological, biochemical and recently genetic aspects of gallstones. Recent studies have emphasized the importance of identifying risk factors for gallstone formation, improving surgical techniques, and assessing long-term outcomes of different surgical approaches. [8] The objective of the study was to comprehensively evaluate the demographic profile, clinical presentation, surgical outcomes, and histopathological and biochemical characteristics of gallstones to enhance patient management and support the training of upcoming surgeons.

Materials and Methods

This prospective study was conducted at Tertiary care Hospital over a period of 18 months after getting ethical clearance from RRMCH-IEC/2014. A total of 58 consecutive patients presenting with clinical features suggestive of calculous cholecystitis were evaluated and underwent ultrasonography for diagnostic confirmation. Following confirmation, all consecutive eligible patients were enrolled into the study based on predefined inclusion and exclusion criteria, after obtaining informed consent.

Inclusion Criteria: All cases diagnosed as calculous cholecystitis.

Exclusion Criteria: Patients diagnosed with acalculous cholecystitis. Patients below 18 years of age presenting with either calculous or acalculous cholecystitis.

A detailed history was taken for all 58 patients based on a structured proforma approved by the guide. Information regarding age, religion, socioeconomic status, nature and duration of symptoms, past history of similar complaints, dietary habits, alcohol intake, diabetes, and other comorbid conditions were recorded.

Preoperative Assessment: All patients underwent a series of laboratory and imaging investigations, which included complete blood count (CBC), blood sugar levels, kidney function test (KFT), liver function tests (LFT), electrocardiography (ECG), urinalysis, blood grouping, chest X-ray, and abdominal ultrasonography. For patients with associated medical conditions, relevant specialist consultations were obtained, and necessary preoperative management was provided to optimize their condition before surgery. The risks and complications of the condition, as well as available surgical options (laparoscopic or open cholecystectomy), were explained to the patients. Patients were given the choice of selecting their preferred surgical procedure based on their financial affordability and the medical indications or contraindications involved.

All patients received a preoperative dose of antibiotics. The choice of surgical approach was either laparoscopic or open cholecystectomy, depending on individual case factors.

Laparoscopic Cholecystectomy: The majority of cases underwent laparoscopic cholecystectomy.

Open Cholecystectomy: Cases requiring open cholecystectomy included those with prior surgical adhesions, difficult anatomical variations, or other contraindications for laparoscopic surgery. Patients with a preoperative diagnosis of common bile duct (CBD) dilation or CBD stones underwent CBD exploration.

During surgery, pathological features and anatomical variations were documented. Bile samples were aspirated from the gallbladder using a sterile syringe. Gram staining was performed directly on the aspirate. For culture, samples were inoculated onto blood agar, MacConkey agar, and thioglycollate broth and incubated at 35–37°C for 24–48 hours. Bacterial isolates were identified using standard biochemical tests, and antimicrobial susceptibility testing was performed according to CLSI (Clinical and Laboratory Standards Institute) guidelines.

In open cholecystectomy cases, a subhepatic tube drain was placed and connected to a urobag for drainage.

Postoperative management included antibiotic therapy and routine post-surgical monitoring. Patients were closely observed for any complications. The abdominal wound was closed in layers, and gallstones were sent for chemical analysis while the gallbladder was submitted for histopathological examination.

For patients who underwent open cholecystectomy, the abdominal drain was removed between the third and fifth postoperative day. Sutures were removed between the seventh and tenth postoperative day, and patients were discharged by the seventh postoperative day unless complications necessitated prolonged hospitalization.

Upon discharge, patients were provided with dietary and activity recommendations and were advised to attend regular follow-ups at the surgical outpatient department (OPD) to monitor recovery and manage any postoperative concerns. Gallbladder specimens were fixed in 10

Statistical analysis was performed using SPSS software version 22 and graphs are created by using excel 2016 software. An Independent t-test was applied for continuous variables such as daily caloric intake, while Chi-square test or Fisher's exact test (where appropriate) was used for categorical variables. All tests were two-tailed, and a significance level of $\alpha = 0.05$ was considered statistically significant.

Results

This study included a total of 58 cases that were studied prospectively over 18 months. The youngest patient was a 20-year-old female, and the oldest was an 86-year-old female. Table 1 shows the highest incidence of cases was observed in the age group of 21 to 30 years, comprising 16 cases (27.58% of the total), all of whom were female. This was followed by 11 cases (18.96%) in the 31 to 40 years age group, with 2 males and 9 females. Overall, there was a female preponderance, with 39 female patients (67.24%) compared to 19 male patients (32.76%), resulting in a male-to-female ratio of 1:2.

Regarding clinical features, all patients presented with abdominal pain, with 49 cases (84%) experiencing right hypochondriac pain and 9 cases (16%) presenting with epigastric pain. The nature of pain was colicky in 46 cases (79%) and dull aching in 12 cases (21%). Pain radiated to the back in 57 cases (98%), while only one patient (2%) had radiation to the shoulder. The most common associated symptom was flatulent dyspepsia, seen in 50 cases (86%), followed by nausea and vomiting in 16 cases (28%). Jaundice was noted in 2 patients (3%), and fever was observed in 3 patients (5%). On physical examination, all patients had upper abdominal tenderness, 2 patients (3%) had icterus, and one patient (2%) had a palpable gallbladder, which was later diagnosed as a mucocele of the gallbladder.

For surgical treatment, patients with jaundice received preoperative management, including intravenous fluids, vitamin K, and antibiotics before undergoing elective surgery. Figure 1 A The pie chart illustrates that among 58 cases, 36 patients (62%) underwent laparoscopic cholecystectomy, while 22 patients (38%) underwent open cholecystectomy. Of these, one patient (2%) required a subtotal cholecystectomy due to dense adhesions from a prior laparotomy, and three patients (5%) underwent open cholecystectomy with common bile duct (CBD) exploration. On Histopathological examination 54 cases (93%) diagnosed as chronic cholecystitis, 3 cases (5%) with acute-on-chronic cholecystitis, and 1 case (2%) with acute cholecystitis as shown in Figure 1B. Figure 2 A and B Shows intraoperative exposure of Calot's triangle and CBD exploration respectively. One of these patients underwent choledochojejunostomy with side-to-side jejunojejunostomy. Four patients required conversion from laparoscopic to open cholecystectomy due to dense adhesions and scarring in Calot's triangle, obscuring anatomical landmarks.

With respect to dietary habits, 53 patients (91%) consumed a mixed diet, while 5 (9%) were vegetarians. Obesity, defined as a BMI ¿30 kg/m², was noted in only 30 cases (51.7%), while 28 patients (48.2%) were non-obese. All patients underwent ultrasound as the initial diagnostic modality, confirming gallstones. Multiple calculi were present in 39 cases (67%), while solitary calculi were seen in 19 cases (33%). Two cases (3%) had a dilated common bile duct (CBD), and subsequent CT scans confirmed CBD dilatation with intrahepatic biliary radical dilation [Figure 2 C] shows Ultrasonography showing multiple stones Gall bladder. Routine blood investigations, including complete blood count, blood sugar, renal function tests, and urinalysis, were normal in all cases, except for 2 patients who had elevated serum bilirubin levels.

Postoperative complications were observed in 6 cases, all of which had wound infections following open cholecystectomy and were treated with appropriate antibiotics categorized as Clavein Dindo grade 1 classification.[9] No patients in either surgical group experienced primary haemorrhage, bile leakage, or chest infection. The mean postoperative hospital stay was 6 days for laparoscopic cholecystectomy and 10 days for open cholecystectomy.

Histopathological examination of the gallbladder specimens revealed that 17 cases (29%) had enlarged gallbladders, 14 cases (24%) had normal-sized gallbladders, and 27 cases (47%) had contracted gallbladders. Gallbladder specimens showed mixed-type gallstones with mucocele and histology consistent with chronic cholecystitis shown in [Figure 2D-H]. The gallbladder wall was thickened in 28 cases (48%), thinned out in 3 cases (5%), and normal in 27 cases (47%).

Table 2 Shows various type of gallstone in present study in which 48 cases (83%) had pigmented black stones, 6 cases (10%) had mixed stones, and 4 cases (7%) had cholesterol stones. Bile culture and Gram staining were performed for all patients, with 3 cases showing pus cells on Gram staining and 1 case revealing gram-negative bacilli. However, no bacterial growth was observed after 48 hours, likely due to the preoperative antibiotic prophylaxis administered to all patients.

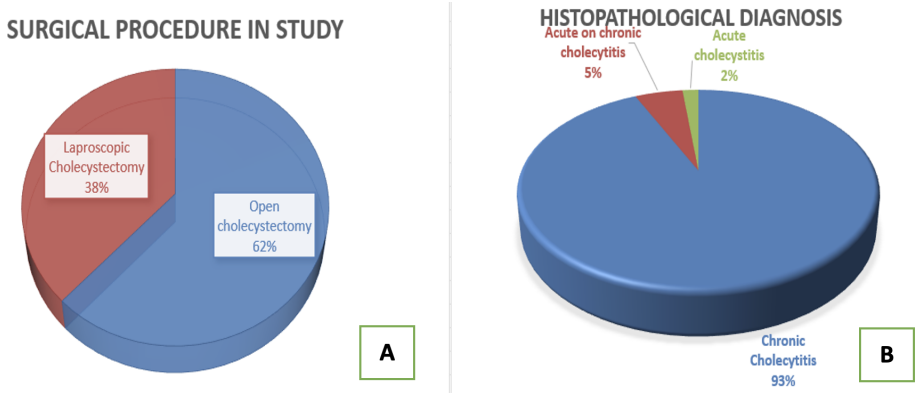

Figure 1: Figure 1. Showing pie chart of type of surgery in various cases and b showing histopathology diagnosis in various cases.

As shown in Table 3 In our laparoscopic cohort, obese patients with gallbladder stones demonstrated significantly higher caloric intake (2450 $\pm$ 320 kcal), greater fat consumption (70% consuming ¿30% of daily calories from fat), more frequent intake of fried and refined carbohydrate-rich foods (67%), and lower fiber intake (23%) compared to non-obese stone-forming patients, who had comparatively healthier diets (fiber intake in 68%, lower fried food consumption at 21%).

Table 1: Table 1. Showing age distribution and male and female cases.

Age in years	Male cases	Female cases	Total
$<$ 20	0	1	1 (1.72%)
21 to 30	0	16	16 (27.58%)
31 to 40	2	9	11 (18.96%)
41 to 50	6	4	10 (17.24%)
51 to 60	4	5	9 (15.51%)
61 to 70	5	2	7 (12.28%)
71 to 80	2	1	3 (5.17%)
$<$ 90	0	1	1 (1.72%)
Total	**19 (32.76%)**	**39 (67.24%)**	**58 (100%)**

Table 2: Table 2. Showing type of gall stones among the cases.

Type of Gall Stone	Number of Cases	Percentage
Pigmented Black	48	83%
Mixed	6	10%
Cholesterol Stones	4	7%

Table 3: Table 3. Showing dietary habits in cases of gall bladder stone in obese and non-obese cases (kcal/day = Kilo calorie per day, g/day = gram per day).

Dietary Parameter	Obese (n = 30)	Non-Obese (n = 28)	p-value	Statistical Test Used	Remarks
Mean Daily Caloric Intake (kcal/day)	2450 $\pm$ 320	1850 $\pm$ 280	$<$ 0.001	Independent t-test	Significantly higher in obese
Fat Consumption (>30% of total calories)	21 (70%)	9 (32%)	0.003	Chi-square test	More common in obese
Frequency of Fried Food Intake ($\geq$3/week)	19 (63%)	6 (21%)	0.001	Chi-square test	Significant difference
High Fiber Intake ($\geq$25g/day)	7 (23%)	19 (68%)	$<$ 0.001	Chi-square test	More in non-obese
Predominantly Vegetarian Diet	2 (7%)	3 (11%)	0.65	Fisher's exact test	Not statistically significant
Mixed Diet (veg + non-veg)	28 (93%)	25 (89%)	0.65	Fisher's exact test	Similar across groups
Sweet/Refined Carb Intake (frequent)	20 (67%)	8 (29%)	0.002	Chi-square test	More in obese group

Discussion

Our study on 58 cases of calculous cholecystitis at tertiary care institute provides valuable insights into the epidemiology, clinical presentation, surgical management, histopathology, and biochemical characteristics of gallstones. The findings are compared with existing literature to identify trends and variations in disease presentation and management.

Figure 2: Figure 2. A-H; shows intraoperative radiological, gross and microscopic images of gall bladder cases a. exposure of Calot's triangle, b. CBD exploration, c. ultrasonography showing multiple stones of gall bladder, d. gall bladder specimen with stones of mixed variety, e. cut open specimen of mucocele of gall bladder with 2.5 cm diameter cholesterol stones, f. gall bladder specimen with pigment stones, g. and h. microscopic image of chronic cholecystitis specimen showing lymphocytic infiltration with fibrosis (haematoxylin and eosin stained slides).

The highest incidence was observed in the third and fourth decades (26% and 19%, respectively), which aligns with findings by Pradhan et al [10] (18.75%) and Thamil et al. [11] (15.38%) but differs slightly from Mohan et al. [12], who reported peak incidence in the fourth decade. This variation may be due to regional dietary and genetic factors.

A female predominance was observed with a male-to-female ratio of 1:2, consistent with previous studies such as those by Syam Sunder et al. (1:1.5) [13], Pradhan SB et al. (1:3.2) [10], and Mohan H et al. (1:6.4) [12]. The increased incidence in females may be attributed to hormonal influences, including the role of estrogen in cholesterol supersaturation and gallstone

formation reported by Chuang et al., 2021 [14].

Our study found a high predominance of mixed diet consumers (Mixed:Veg Ratio of 10:1), similar to Pradhan SB et al. (9:1) [10] and Selvaraju et al. (1.4:1) [15]. High-fat and protein diets are known risk factors for gallstone formation, supporting the hypothesis that dietary modifications could play a preventive role in high-risk populations as reported by Shabanzadeh et al.[16].

Pain was the most common symptom (100% of cases), predominantly in the right hypochondrium (84.5%). This aligns with findings by Pradhan SB et al. [10] (65%) and Thamil et al. (61.5%) [16]. The variation in epigastric pain incidence in present study 15.5% vs. 57.5% in Pradhan et al. [10], suggests differences in pain perception and reporting. Tenderness in the upper abdomen was the most consistent physical sign (100%), significantly higher than the 11.7% reported by Wani NA et al. [17] The lower prevalence of icterus (3.4%) and palpable mass (1.72%) in our study aligns with previous findings and highlights the importance of ultrasound for early detection.

Ultrasound identified multiple calculi in 67% of cases and solitary calculi in 33%, similar to findings by Syam Sundar et al. [13] (83.3% multiple calculi). This supports the view that multiple gallstones are more common in chronic cholecystitis cases as per Portincasa et al. [18].

The mean postoperative stay was 10 days for open cholecystectomy and 6 days for laparoscopic cholecystectomy, longer than reported by Hardy KJ et al. [19] (6.5 and 2 days, respectively). This may be due to variations in hospital protocols, patient comorbidities, and perioperative care strategies reported by Reese et al., 2022 [20].

Chronic cholecystitis was the predominant histopathological diagnosis (93%), closely aligning with Thamil et al. (87%). Acute cholecystitis was observed in 2% of cases, consistent with Thamil et al. [11] (2.5%). Thickened gallbladder walls were seen in 48% of cases, similar to Syam Sundar et al. [13] (41.66%). Histopathological analysis remains crucial in differentiating benign from premalignant conditions, especially in high-risk populations reported by Shen et al.2020 [21].

On Biochemical Analysis of Gallstones pigmented stones were the most common (83%), followed by mixed stones (10%) and cholesterol stones (7%). This differs from Mohan H et al. [12] (62.3% mixed stones) and Pradhan SB et al. (78.75% mixed stones) [10]. The predominance of pigmented stones in our study may indicate a higher prevalence of haemolytic conditions or biliary infections in our population as published by Jensen KH, et al. [22].

In our study as per Table 3 obese individuals with gallstones exhibited significantly higher daily caloric and fat intake, frequent consumption of fried and refined carbohydrate-rich foods, and lower fiber intake compared to non-obese individuals. These findings align with previous Indian studies indicating that a high-fat, low-fiber diet and obesity are strongly associated with cholesterol or mixed gallstone formation, especially in Northern India[23, 24]. Singh et al.[23] and Gupta et al.[25] reported that over 60% of obese North Indian patients with gallstones consumed excess dietary fat and processed foods, correlating with a predominance of cholesterol stones. In contrast, our non-obese patients, many from South India, demonstrated healthier diets but still developed gallstones—indicating a non-metabolic pathogenesis, likely pigment stones, which are more common in Southern populations. Sharma et al.[26] also highlighted that obese patients from Rajasthan predominantly had cholesterol/mixed stones, while non-obese patients more frequently harbored pigment stones.

This regional variation is further supported by studies from Karnataka and other parts of South India. A study from KIMS, Hubli, Karnataka, analyzing gallstones from 39 patients, found mixed stones (38%) followed closely by pigment stones (36%), with cholesterol stones being the least common (26%)[27]. Another large case–control study from South India reported that consumption of tamarind, spicy foods, and fried items increased gallstone risk even in lean individuals, and pigment stones were notably more frequent [28]. Moreover, a cadaveric (autopsy) study conducted in South India, including Karnataka, found a gallstone prevalence of 4.87% among 123 postmortem cases, and notably, 83.3% of these were pigment stones, further reinforcing regional dietary and non-metabolic influences in pigment stone formation [29]. In addition to environmental and dietary factors, emerging evidence suggests that genetic polymorphisms may contribute to regional differences in gallstone composition. Variants in the UGT1A1 gene, particularly the UGT1A1 28 polymorphism, have been associated with impaired bilirubin conjugation, leading to increased risk of black pigment stone formation due to elevated unconjugated bilirubin levels[30].

These findings underscore the need for region-specific gallstone prevention strategies—emphasizing metabolic control and dietary fat reduction in North India, while addressing chronic infections, dietary triggers (such as tamarind and spices), and underlying genetic susceptibilities in South India.

Limitation

The study is limited by its small sample size and single-center design, which may restrict the applicability of results to the broader population. Larger multicentric studies along with genetic evaluation of specific gene are needed to confirm regional and dietary associations with gallstone types.

Conclusion

This study highlights key demographic, clinical, and pathological trends in calculous cholecystitis, emphasizing the need for tailored management strategies. The variations in gallstone composition suggest that further research into genetic predispositions and metabolic factors is warranted. Additionally, the longer postoperative stay in our cohort indicates a need to optimize perioperative protocols to enhance recovery and reduce hospital stays. Future studies with larger sample sizes and multicentre collaborations can provide deeper insights into regional variations and improve patient care strategies.

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