

Biochemical Composition of Gall Stones among the Indian Population

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Received: 11-08-2024 / Revised: 12-09-2024 / Accepted: 25-10-2024

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Conflict of interest: Nil

Abstract

Introduction: Gallstones, a common biliary disorder in India, are classified as cholesterol, pigment, or mixed types, influenced by genetics, diet, obesity, and metabolic syndrome. This study aims to analyze the biochemical composition of gallstones in the Indian population, focusing on regional and demographic variations to guide prevention and treatment strategies.

Methods: This prospective study, conducted at Konaseema Institute of Medical Sciences, analyzed gallstones from cholecystectomy patients (aged >18 years) between August 2022 and May 2024. Gallstones were biochemically classified as cholesterol, pigment, or mixed. Patient data, clinical features, and findings were statistically analyzed using SPSS, with significance set at $P < 0.005$.

Results: Among 50 participants, 30% were male, with the majority (32%) aged 41–50 years. Abdominal pain was the most common symptom. USG revealed multiple stones in 39%. Mixed stones were predominant (74%), followed by pigment (16%) and cholesterol stones (10%). Grade 1 cholecystitis was most frequent (78%), followed by grade 2 (20%).

Conclusion: This study underscores the high prevalence of mixed gallstones and grade 1 cholecystitis in the Indian population, highlighting the importance of early detection and management. Regional dietary and metabolic factors significantly influence gallstone composition, emphasizing the need for targeted prevention and treatment strategies. Limitations include the small sample size and single-center design.

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Introduction

Gallstones are a common biliary disorder, particularly in the Indian subcontinent, where their prevalence is rising due to lifestyle changes and dietary habits. Gallstones are classified into cholesterol, pigment, and mixed types based on their biochemical composition [1]. Among the Indian population, cholesterol and mixed gallstones are more prevalent, particularly in northern regions. The formation of gallstones is influenced by multiple factors, including genetic predisposition, diet, obesity, and metabolic syndrome, which are all prevalent in India [2, 3].

Cholesterol gallstones are primarily composed of cholesterol, which can crystallize in the bile when cholesterol saturation occurs, often due to dietary

fat intake and reduced physical activity. Pigment stones, on the other hand, consist of calcium bilirubinate, and are more frequently observed in conditions like hemolytic anemia and infections of the biliary tract, both of which are significant public health concerns in India. Mixed stones contain varying amounts of cholesterol and calcium salts [4, 5]. The prevalence of these different types of stones varies with geographic location, socioeconomic factors, and gender, with a higher incidence noted in females due to hormonal influences.

Understanding the biochemical composition of gallstones is essential for improving prevention and treatment strategies, as it helps in identifying risk

factors and guiding dietary and medical interventions. This study aims to analyze the biochemical composition of gallstones in the Indian population, focusing on regional and demographic variations, and to provide insights into preventive measures based on these findings.

Methods

It was prospective research conducted in the department of general Surgery, Konaseema Institute of Medical Sciences & Research Foundation, Amalapuram. Study was conducted between August 2022 to May 2024. Study protocol was approved by the Institutional Ethics committee. An informed consent was taken from the study participants.

The inclusion criteria consist of all patients with calculous cholecystitis undergoing cholecystectomy, aged ≥ 18 years, and encompassing both male and female genders. Non cooperative individuals were not considered in the research.

Patients were screened preoperatively through clinical evaluation, biochemical tests, and imaging studies, including ultrasonography (USG) to confirm the presence of gallstones. Based on these assessments, patients were scheduled for elective or emergency cholecystectomy. Cholecystectomy was performed either laparoscopically or through open surgery, depending on the patient's clinical condition, surgeon's expertise, and availability of laparoscopic instruments. After the procedure, gallbladder specimens containing the stones were collected and sent to the laboratory for biochemical analysis.

The biochemical composition of the gallstones was determined using standard analytical methods. Gallstones were categorized into cholesterol, pigment, and mixed types based on their composition. Cholesterol stones were identified by their high cholesterol content, pigment stones by the presence of calcium bilirubinate, and mixed stones by a combination of cholesterol and calcium salts. Data related to patient demographics, clinical features, operative findings, and biochemical analysis were collected and recorded in a structured format.

Statistical analysis

Statistical analysis was performed using SPSS software. Chi square test was used to find the statistical significance. $P < 0.005$ was considered to be statistically significant.

Results

Total 50 members were included, 30% (15) were male and maximum (32%; 16) in 41 – 50 years group. Pain abdomen was the common clinical presentation. USG finding showed that multiple

stones in 39% (78). Mixed stones were detected in 37 (74%) followed by pigment stones (8; 16%) cholesterol stones (5; 10%). When the severity of cholecystitis was considered, grade 1 was the leading (39; 78%) followed by grade 2 (10; 20%) and grade (2%).

Discussion

In India, the prevalence of cholecystitis, particularly calculous cholecystitis, is increasing due to changing dietary patterns, sedentary lifestyles, and rising obesity rates [6]. Women, especially from northern regions, are more commonly affected due to higher cholesterol levels and hormonal factors. Late presentation and complications like empyema or gangrenous cholecystitis are frequently observed in rural areas due to limited access to healthcare. [7, 8] The shift towards laparoscopic cholecystectomy has improved outcomes, though open surgery remains common in resource-limited settings.

The study included 50 participants, of which 30% (15) were male, and the majority (32%; 16) belonged to the 41–50 years age group. Abdominal pain emerged as the most common clinical presentation, consistent with global patterns of gallstone disease. This gender and age distribution aligns with previous studies indicating that gallstones are more prevalent in middle-aged individuals, with females exhibiting a higher risk due to hormonal influences, including estrogen-mediated changes in bile composition. [9] Pain in the upper abdomen, often postprandial, is a hallmark of gallstone disease, frequently associated with inflammation of the gallbladder. Age-related metabolic changes and lifestyle factors, such as dietary habits and reduced physical activity, further contribute to gallstone formation in this demographic. [10] The study's findings underscore the importance of early diagnosis and tailored interventions to mitigate complications, particularly in high-risk groups. [11]

In this study, mixed gallstones were most prevalent, identified in 74% of cases, followed by pigment stones (16%) and cholesterol stones (10%). Mixed stones, composed of cholesterol and calcium salts, reflect complex interactions between bile constituents, often influenced by dietary patterns, metabolic disorders, and regional factors. [12] The high prevalence of mixed stones aligns with findings from Indian studies, where dietary carbohydrate intake and obesity significantly contribute to gallstone formation. Pigment stones, primarily composed of calcium bilirubinate, are often linked to hemolytic disorders and biliary infections, which are common in the Indian population due to specific environmental and health factors. [13] Cholesterol stones, typically associated with high-fat diets and sedentary

lifestyles, remain less common, reflecting regional dietary habits and lifestyle. [14] These findings emphasize the need for biochemical profiling of gallstones to guide prevention strategies, dietary modifications, and targeted interventions for at-risk populations.

In this study, the majority of cholecystitis cases were classified as grade 1 (78%), followed by grade 2 (20%), with only 2% presenting as grade 3. Grade 1, or mild cholecystitis, typically represents early-stage inflammation, often responding well to conservative management or elective cholecystectomy. [15] The predominance of grade 1 cases aligns with findings from Indian clinical settings, where early detection through ultrasonography and clinical evaluation is common. Grade 2, or moderate cholecystitis, reflects progression with associated systemic inflammation, often requiring urgent intervention. [16] Grade 3, the severe form with systemic complications such as organ dysfunction, remains less frequent but poses significant risks. [17] The findings underscore the importance of early diagnosis and intervention in preventing progression to severe cholecystitis, highlighting the role of routine imaging and prompt surgical management in improving outcomes.

Sample size was relatively small, and the findings were specific to a single institution, limiting generalizability. Additionally, the study did not explore long-term outcomes or the impact of comorbidities on gallstone formation and cholecystitis severity. This study highlights the predominance of mixed gallstones and grade 1 cholecystitis among the Indian population, emphasizing the role of early diagnosis and management in improving outcomes. The findings underscore dietary, metabolic, and environmental factors influencing gallstone composition and disease severity. Understanding these patterns can guide preventive and therapeutic strategies tailored to regional needs.

References

1. Tandon R K, Sharma R. Epidemiology and risk factors for gallstone disease in India. *Indian Journal of Gastroenterology*. 2022; 41(2): 107 – 15.
2. Singh V, Jain M, Pandey G. Biochemical analysis of gallstones: A cross-sectional study from North India. *Journal of Clinical and Diagnostic Research*. 2022; 16(7): OC01 – 5.
3. Sharma A, Agarwal S, Malhotra R. Gallstone composition and its correlation with body mass index and diet. *BMC Gastroenterology*. 2022; 22: 190.
4. Verma S, Singh S, Joshi P. Comparative study of cholesterol and pigment stones in different regions of India. *Indian Journal of Surgery*. 2022; 84: 653 – 60.
5. Patel M, Rao P, Desai N. Regional variations in the biochemical composition of gallstones: A multicentric study. *World Journal of Gastroenterology*. 2022; 28(20): 2656 – 65.
6. Patel S, Singh R, Verma A. Trends in gallstone disease and cholecystitis in India. *Ind. J of Gast*. 2023; 42(3): 195 – 202.
7. Sharma K, Gupta R, Mehta A. Current surgical management of acute cholecystitis in India: A nationwide survey. *World Journal of Surgery*. 2023; 47(4): 801 – 9.
8. Reddy D, Rao P, Thomas G. The impact of socioeconomic factors on gallstone disease in India. *BMC Gastroenterology*. 2023; 23(1): 250.
9. Shaffer EA. Epidemiology of gallstone disease. *Best Pract Res Clin Gastroenterol*. 2006; 20(6): 981 – 96.
10. Stinton LM, Shaffer EA. Epidemiology of gallbladder disease: Cholelithiasis and cancer. *Gut Liver*. 2012; 6(2): 172 – 87.
11. Shabanzadeh DM. Incidence of gallstone disease and complications. *Curr Opin Gastroenterol*. 2018; 34(2): 81 – 9.
12. Chattopadhyay R, Ganguly P. Biochemical composition of gallstones: A comparative study in urban and rural populations of India. *J Clin Diagn Res*. 2022; 16(3): MC01 – MC04.
13. Sharma A, Gupta S. Pigment gallstones in the Indian subcontinent: Etiopathogenesis and clinical implications. *Ann Hepatobiliary Pancreat Surg*. 2021; 25(4): 457 – 62.
14. Verma S, Rajesh R. Diet and metabolic disorders in gallstone formation: Evidence from India. *Curr Med Res Opin*. 2023; 39(5): 675 – 81.
15. Yokoe M, Takada T, Hwang TL, et al. Updated Tokyo Guidelines for the management of acute cholecystitis. *J Hepatobiliary Pancreat Sci*. 2018; 25(1): 55 – 72.
16. Singh V, Trikha S, Nain CK. Acute cholecystitis: Clinical spectrum and outcomes in India. *Indian J Surg*. 2021; 83(6): 1345 – 50.
17. Ansari D, Torén W, Lindberg S, et al. Diagnosis and management of acute cholecystitis. *Scand J Gastroenterol*. 2017; 52(11): 1240 – 5.