



AN OBSERVATIONAL STUDY ON THE ASSOCIATION BETWEEN GALLSTONE DISEASE AND METABOLIC SYNDROME

General Surgery

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ABSTRACT

Background: Gallstone disease (GSD) and metabolic syndrome (MetS) are two common health problems worldwide, and a growing body of evidence suggests a strong association between them. This study aimed to determine the prevalence of MetS and its components among patients with GSD in a tertiary care hospital in India. **Methods:** An observational, cross-sectional study was conducted on 406 patients aged 18 years and above, diagnosed with gallstone disease. The diagnosis of MetS was made based on the National Cholesterol Education Program Adult Treatment Panel III (NCEP ATP III) criteria, modified for South Asians. Data on demographic, clinical, anthropometric, and biochemical parameters were collected and analyzed using appropriate statistical tests. **Results:** The study included 406 patients with GSD, with a mean age of 47.6 years. Females constituted the majority of the patients (75.6%). The prevalence of MetS in patients with GSD was found to be 73.89%. The most prevalent component of MetS was high blood pressure (82.76%), followed by low HDL cholesterol (61.58%), elevated waist circumference (61.82%), high triglycerides (58.62%), and high fasting glucose (58.37%). MetS was significantly more prevalent in females (79.15%) compared to males (57.58%). A high prevalence of MetS was observed across all age groups, including younger adults (77.91% in the 18–29 years age group). **Conclusion:** The high prevalence of metabolic syndrome in patients with gallstone disease highlights a strong association between the two conditions. This underscores the need for routine screening for MetS in patients with GSD to facilitate early diagnosis and management of associated cardiometabolic risks, which can help in reducing perioperative complications and long-term morbidity.

KEYWORDS

Gallstone Disease, Metabolic Syndrome, Cholelithiasis, Prevalence, Risk Factors, NCEP ATP III.

INTRODUCTION

Gallstone disease (GSD) is one of the most common digestive disorders, with a global prevalence ranging from 10% to 20% in adults. While many individuals with GSD remain asymptomatic, a significant proportion develops symptoms like biliary colic or complications such as acute cholecystitis, pancreatitis, or cholangitis, often necessitating surgical intervention. The formation of gallstones, particularly cholesterol gallstones, is a multifactorial process involving genetic predisposition, dietary habits, and metabolic factors.^[1]

Metabolic syndrome (MetS) is a cluster of interrelated metabolic abnormalities, including central obesity, insulin resistance, dyslipidemia (elevated triglycerides and low high-density lipoprotein [HDL] cholesterol), and hypertension. The syndrome is a major risk factor for type 2 diabetes mellitus (T2DM) and cardiovascular disease. The global prevalence of MetS is estimated to be around 20-25%, with a rising trend in developing countries like India due to rapid urbanization and lifestyle changes.

Recent research has pointed towards a significant association between GSD and MetS. The pathophysiological mechanisms linking MetS and GSD are thought to include insulin resistance leading to increased biliary cholesterol secretion, dyslipidemia promoting cholesterol supersaturation in bile, and central obesity contributing to both increased cholesterol synthesis and gallbladder stasis.^[1]

The co-existence of GSD and MetS has important clinical implications. Patients with both conditions may have a higher risk of complicated gallstone disease and may face increased perioperative risks during cholecystectomy. Identifying MetS in GSD patients can help in preoperative optimization, lifestyle counseling, and long-term prevention of cardiovascular events.

This study was conducted to determine the prevalence of metabolic syndrome and its components in patients diagnosed with gallstone

disease at a tertiary care center in India and to analyze the association between the two conditions.

MATERIALS AND METHODS

Study Design and Setting

This was an observational, cross-sectional study conducted in the Department of General Surgery at Sawai Man Singh (SMS) Medical College, Jaipur, India. A total of 406 patients diagnosed with gallstone disease were enrolled in the study using a consecutive sampling technique.

Inclusion and Exclusion Criteria

Patients aged 18 years and above with a diagnosis of gallstone disease confirmed by ultrasonography were included in the study. Patients with a history of liver disease (e.g., viral hepatitis, alcoholic liver disease), malignancy, or those who were pregnant were excluded.

Data Collection

After obtaining informed written consent, a detailed history was taken from each participant using a pre-designed proforma. The data collected included demographic details, personal and family history of GSD, diabetes, hypertension, and other comorbidities. Anthropometric measurements such as height, weight, Body Mass Index (BMI), and waist circumference were recorded. Blood pressure was measured in the sitting position after a 5-minute rest. Venous blood samples were collected after an overnight fast of at least 8 hours for biochemical analysis, including fasting plasma glucose, serum triglycerides, and HDL cholesterol.

Diagnosis of Metabolic Syndrome

Metabolic syndrome was diagnosed based on the NCEP ATP III criteria, with modified cut-offs for waist circumference for South Asians, as recommended by the International Diabetes Federation (IDF). A patient was diagnosed with MetS if they had three or more of the following five criteria:^[1]

1. Waist Circumference: ≥ 90 cm in males or ≥ 80 cm in females.
2. Triglycerides: ≥ 150 mg/dL or on drug treatment for elevated triglycerides.
3. HDL Cholesterol: < 40 mg/dL in males or < 50 mg/dL in females, or on drug treatment for reduced HDL.
4. Blood Pressure: Systolic blood pressure ≥ 130 mmHg or diastolic blood pressure ≥ 85 mmHg, or on antihypertensive treatment.
5. Fasting Plasma Glucose: ≥ 100 mg/dL or on treatment for elevated glucose.

Statistical Analysis

The collected data were entered into a master chart and analyzed using Statistical Package for the Social Sciences (SPSS) software. Categorical variables were presented as frequencies and percentages, and the association between them was assessed using the Chi-square test. Continuous variables were presented as mean $\pm$ standard deviation, and the independent sample t-test was used to compare means between groups. A p-value of < 0.05 was considered statistically significant.

RESULTS

A total of 406 patients with gallstone disease were included in the study. The demographic and clinical characteristics of the study population are summarized below.

Demographic and Clinical Profile

The age of the patients ranged from 18 to over 60 years, with a bimodal distribution showing peaks in the 18–29 years and ≥ 60 years age groups. The majority of the patients were female (307, 75.6%), while 99 (24.4%) were male, giving a female-to-male ratio of 3.1:1. The most common clinical presentation was biliary colic (63.0%), followed by acute cholecystitis (20.0%), while 17.0% of patients were asymptomatic.

Prevalence of Metabolic Syndrome and its Components

The overall prevalence of metabolic syndrome in patients with gallstone disease was 73.89% (300 out of 406 patients). The prevalence of individual components of MetS is shown in Table 1.

Table 1: Prevalence of Metabolic Syndrome Components (n=406)

Component	Diagnostic Threshold	Number of Subjects	Percentage (%)
Elevated Blood Pressure	$\geq 130/85$ mmHg or on medication	336	82.76
Low HDL Cholesterol	< 40 mg/dL (M) / < 50 mg/dL (F)	250	61.58
Elevated Waist Circumference	≥ 90 cm (M) / ≥ 80 cm (F)	251	61.82
Elevated Triglycerides	≥ 150 mg/dL	238	58.62
Elevated Fasting Glucose	≥ 100 mg/dL	237	58.37

The study found that a majority of patients with GSD had multiple components of MetS. As shown in Table 2, 32.02% of patients met three criteria for MetS, 29.56% met four criteria, and 12.32% met all five criteria.

Table 2: Distribution of Patients by Number of MetS Criteria Fulfilled

No. of MetS Criteria Fulfilled	Number of Subjects (n)	Percentage (%)
0	3	0.74
1	17	4.19
2	86	21.18
3	130	32.02
4	120	29.56
5	50	12.32
Total	406	100.00

Association of Metabolic Syndrome with Gender and Age
Metabolic syndrome was found to be significantly more prevalent in females (243 out of 307, 79.15%) than in males (57 out of 99, 57.58%) ($p < 0.001$). The prevalence of MetS was high across all age groups, including younger adults, with the highest prevalence in the 50–59 age group (78.05%) (Table 3).

Table 3: Association of Metabolic Syndrome with Age Group

Age Group (Years)	MetS Present (n)	MetS Absent (n)	Total (n)	Prevalence of MetS (%)
18–29	67	19	86	77.91
30–39	45	17	62	72.58
40–49	53	22	75	70.67
50–59	64	18	82	78.05
≥ 60	71	30	101	70.30
Total	300	106	406	73.89

DISCUSSION

This study found a high prevalence of metabolic syndrome (73.89%) among patients with gallstone disease, which is consistent with the findings of several other studies, reinforcing the strong association between the two conditions. A meta-analysis by Jiang P et al. also reported a significant association between MetS and GSD, with the risk increasing with the number of MetS components.

The high prevalence of MetS in our study cohort was driven by a high frequency of its individual components. Elevated blood pressure was the most common component (82.76%), followed by low HDL, central obesity, hypertriglyceridemia, and elevated fasting glucose. This pattern is similar to a study by Chen L-Y et al., which also found a dose-response relationship between the number of MetS components and the risk of GSD.

Our study also found a significant gender disparity, with females having a higher prevalence of both GSD and MetS. This is in line with the established knowledge that female sex hormones influence bile composition and gallbladder motility, increasing the risk of gallstones. The higher prevalence of central obesity and low HDL among females in our study likely contributes to their increased risk of MetS and GSD. However, some studies, like the longitudinal cohort study by Zhu Q et al., have found the association between MetS and GSD to be stronger in males. These differing findings may be due to variations in study populations and design.^[1]

A concerning finding from our study is the high prevalence of MetS in younger patients with GSD (77.91% in the 18–29 age group). This suggests an early onset of metabolic disturbances in the younger population, likely driven by lifestyle changes, which may be contributing to the development of gallstones at a younger age.

The link between MetS and GSD has been further solidified by a Mendelian randomization study by Zhu Q et al., which suggested a causal relationship, particularly with abdominal obesity being a strong causal factor for cholelithiasis. The pathophysiological link involves insulin resistance, which increases hepatic cholesterol secretion, and dyslipidemia, which leads to cholesterol supersaturation of bile, both of which are central features of MetS.^[1]

The clinical implications of these findings are significant. The presence of MetS in GSD patients can increase the complexity of surgery and the risk of postoperative complications. Therefore, routine screening for MetS in all patients presenting with gallstone disease is warranted. This would allow for preoperative optimization of comorbidities like hypertension and diabetes, and also provide an opportunity for lifestyle counseling to manage MetS and reduce the long-term risk of cardiovascular disease and T2DM.

Limitations

This study has some limitations. Being a hospital-based, cross-sectional study, it may not reflect the prevalence in the general population. The absence of a control group of individuals without gallstone disease limits the ability to establish the strength of the association and to calculate odds ratios. A longitudinal study would be required to establish a temporal relationship between MetS and the development of GSD.

CONCLUSION

This study demonstrates a high prevalence of metabolic syndrome and its components in patients with gallstone disease. The findings highlight a strong association between the two conditions, particularly in females and younger adults. This underscores the importance of screening for metabolic syndrome in all patients with gallstone disease. An integrated approach to management that addresses both the gallstone disease and the underlying metabolic abnormalities is crucial for improving patient outcomes and reducing long-term morbidity and mortality.

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