



CORRELATION OF PREOPERATIVE ULTRASONOGRAPHIC GALLBLADDER WALL THICKNESS WITH OPERATIVE DIFFICULTY DURING CHOLECYSTECTOMY: AN OBSERVATIONAL STUDY AT A TERTIARY CARE HOSPITAL IN BIHAR

Dr. Hira Prasad Singh¹, Dr. Vinod Kumar²

¹ Assistant Professor, Department of General Surgery, Katihar Medical College & Hospital, Katihar, Bihar, India. drhirasinghsurgeon@gmail.com

² Assistant Professor, Department of General Surgery, Katihar Medical College & Hospital, Katihar, Bihar, India. kumarvinod893@gmail.com

***Corresponding Author:** Dr. Hira Prasad Singh

***Department of General Surgery, Katihar Medical College & Hospital, Katihar, Bihar, India.**

ABSTRACT

Background: Laparoscopic cholecystectomy is the standard treatment for symptomatic gallstone disease. However, operative difficulty may arise due to inflammatory changes, adhesions, and distortion of biliary anatomy. Identification of reliable preoperative predictors of difficult cholecystectomy is important for surgical planning and risk stratification. Gallbladder wall thickness measured by ultrasonography has been proposed as a potential predictor of operative difficulty.

Objectives: To evaluate the correlation between preoperative ultrasonographic gallbladder wall thickness and operative difficulty during cholecystectomy in patients with symptomatic gallstone disease.

Methods: A hospital-based observational analytical study was conducted in the Department of General Surgery at a tertiary care hospital in Bihar from August 2005 to November 2005. Thirty-four consecutive patients with symptomatic cholelithiasis undergoing cholecystectomy were enrolled. Preoperative ultrasonography was performed to assess gallbladder wall thickness. Intraoperative difficulty was evaluated using predefined criteria including dense adhesions, difficulty in Calot's triangle dissection, operative duration, intraoperative bleeding, and conversion to open surgery. Statistical analysis was performed using SPSS version 11.0. Associations were assessed using the Chi-square test, while correlation was evaluated using Spearman's rank correlation coefficient. A p-value <0.05 was considered statistically significant.

Results: Among the 34 patients studied, females constituted 70.6% of the study population. Gallbladder wall thickness greater than 3 mm was observed in 41.2% of patients. Dense adhesions and difficult Calot's triangle dissection were the most common indicators of operative difficulty. Difficult surgery occurred in 64.3% of patients with gallbladder wall thickness greater than 3 mm compared with 15.0% of those with wall thickness of 3 mm or less. A statistically significant association was observed between increased gallbladder wall thickness and operative difficulty ($p=0.006$). Gallbladder wall thickness also demonstrated a moderate positive correlation with operative difficulty score (Spearman's $\rho = 0.52$, $p=0.002$).

Conclusion: Preoperative gallbladder wall thickness is significantly associated with operative difficulty during cholecystectomy. Ultrasonographic measurement of gallbladder wall thickness may serve as a useful and practical predictor of technically difficult surgery, thereby aiding preoperative planning and patient counseling.

Keywords: Gallbladder wall thickness; Cholelithiasis; Cholecystectomy; Operative difficulty; Ultrasonography; Surgical outcomes; Gallstone disease

INTRODUCTION

Gallstone disease is one of the most common gastrointestinal disorders requiring surgical intervention worldwide. Cholelithiasis affects a substantial proportion of the adult population, with prevalence varying according to age, sex, ethnicity, and dietary habits. Laparoscopic cholecystectomy has become the gold standard treatment for symptomatic gallstone disease because of its advantages of reduced postoperative pain, shorter hospital stay, faster recovery, and improved cosmetic outcomes compared with open surgery [1]. Despite these benefits, the procedure may occasionally be technically challenging, resulting in prolonged operative time, increased risk of complications, conversion to open surgery, and higher healthcare costs [2].

Operative difficulty during cholecystectomy is influenced by several factors, including acute or chronic inflammation, adhesions, fibrosis, anatomical variations, obesity, and previous abdominal surgeries [3]. Accurate preoperative prediction of difficult cholecystectomy is therefore important for surgical planning, allocation of experienced surgical teams, patient counseling, and optimization of operative outcomes [4]. Various clinical, biochemical, and radiological parameters have been investigated as predictors of operative difficulty, among which ultrasonographic assessment of gallbladder wall thickness has received considerable attention [5].

Gallbladder wall thickening is a recognized manifestation of inflammatory changes associated with acute and chronic cholecystitis. Repeated episodes of inflammation may lead to edema, fibrosis, and adhesions around the gallbladder, making dissection within Calot's triangle more demanding and increasing the risk of bile duct injury [6]. Ultrasonography remains the primary imaging modality for evaluating gallstone disease because it is non-invasive, widely available, cost-effective, and highly sensitive for detecting gallstones and associated gallbladder pathology [7]. Measurement of gallbladder wall thickness can be readily performed during routine preoperative evaluation and may provide valuable information regarding anticipated surgical difficulty.

Several studies conducted in different populations have suggested an association between increased gallbladder wall thickness and difficult laparoscopic cholecystectomy. Patients with a thickened gallbladder wall have been reported to experience longer operative times, greater technical complexity, and higher rates of conversion to open procedures [8]. However, the strength and consistency of this association have varied across studies owing to differences in patient selection, definitions of operative difficulty, imaging protocols, and surgical expertise [9].

In the Indian context, gallstone disease represents a significant surgical burden, particularly in Bihar regions where its prevalence is comparatively high. Tertiary care hospitals frequently encounter patients presenting with recurrent biliary symptoms and varying degrees of gallbladder inflammation. Identifying reliable preoperative predictors of operative difficulty is especially relevant in resource-constrained settings, where efficient utilization of operating room time and surgical manpower is essential [10]. However, limited data are available from Bihar tertiary care centers regarding the correlation between ultrasonographically measured gallbladder wall thickness and intraoperative difficulty.

Considering the potential value of a simple, readily available radiological parameter in predicting operative challenges, further evaluation in local clinical settings is warranted. Such evidence may contribute to improved preoperative risk stratification and surgical decision-making.

The aim of the present study was to evaluate the correlation between preoperative gallbladder wall thickness measured by ultrasonography and operative difficulty during cholecystectomy in patients

with gallstone disease undergoing surgery at a tertiary care hospital in Bihar. The specific objectives were to determine the distribution of gallbladder wall thickness among study participants, assess operative difficulty using predefined intraoperative criteria, and analyze the association between gallbladder wall thickness and operative difficulty.

METHODOLOGY

Study Design: This was a hospital-based observational analytical study designed to evaluate the correlation between preoperative gallbladder wall thickness measured by ultrasonography and operative difficulty encountered during cholecystectomy in patients with gallstone disease.

Study Setting: The study was conducted in the Department of General Surgery of a tertiary care teaching hospital in Bihar. All clinical, radiological, operative, and postoperative data were collected and analyzed within the institution.

Study Duration: The study was conducted over a period of four months from August 2005 to November 2005.

Study Population: The study population comprised patients diagnosed with symptomatic cholelithiasis and scheduled for elective cholecystectomy during the study period.

Inclusion Criteria

- Patients aged 18 years and above.
- Patients diagnosed with symptomatic gallstone disease on ultrasonography.
- Patients planned for cholecystectomy.
- Patients willing to participate and provide written informed consent.

Exclusion Criteria

- Patients with suspected or confirmed gallbladder malignancy.
- Patients presenting with obstructive jaundice due to causes other than gallstone disease.
- Patients with previous biliary tract surgery.
- Patients with severe systemic illness precluding surgery.
- Patients unwilling to provide informed consent.
- Patients with incomplete clinical, radiological, or operative records.

Sample Size: The sample size was determined based on the number of eligible patients presenting during the study period and fulfilling the inclusion criteria.

For an observational correlation study, the sample size may be estimated using the formula:

$$n = (Z\alpha + Z\beta)^2 (1 - r^2) / r^2$$

where:

- n = required sample size
- $Z\alpha$ = standard normal deviate corresponding to 95% confidence level (1.96)
- $Z\beta$ = standard normal deviate corresponding to 80% power (0.84)
- r = anticipated correlation coefficient

Considering the short study duration and the exploratory nature of the study, all consecutive eligible patients were enrolled. A total of 34 patients satisfied the eligibility criteria and were included in the final analysis.

Sampling Technique: Consecutive sampling was employed. All eligible patients presenting during the study period and fulfilling the inclusion criteria were recruited until completion of the study duration.

Data Collection Tools and Procedure: A structured case record form was used for data collection. Demographic details, clinical history, physical examination findings, and relevant laboratory investigations were recorded. All patients underwent preoperative abdominal ultrasonography

performed by experienced radiologists. Gallbladder wall thickness was measured in millimeters at the most representative site and documented. Patients subsequently underwent cholecystectomy as planned. Intraoperative findings including adhesions around the gallbladder, difficulty in dissection of Calot's triangle, difficulty in gallbladder extraction, operative time, bleeding requiring additional hemostatic measures, and conversion to open surgery were recorded. Operative difficulty was assessed by the operating surgeon using predefined intraoperative criteria and categorized as easy or difficult. Data were entered into a master database for analysis.

Study Variables: The independent variable was preoperative gallbladder wall thickness measured on ultrasonography and categorized according to standard radiological assessment. Other baseline variables included age, sex, duration of symptoms, and ultrasonographic findings. The dependent variable was operative difficulty during cholecystectomy, assessed intraoperatively on the basis of adhesions, difficulty in dissection, operative duration, and need for conversion to open surgery. The relationship between gallbladder wall thickness and operative difficulty constituted the primary outcome of interest.

Statistical Analysis: Data were entered into Microsoft Excel and analyzed using Statistical Package for the Social Sciences (SPSS) software version 11.0. Continuous variables were summarized as mean $\pm$ standard deviation, while categorical variables were expressed as frequencies and percentages. The association between gallbladder wall thickness categories and operative difficulty was evaluated using the Chi-square test or Fisher's exact test wherever appropriate. Correlation between gallbladder wall thickness and operative difficulty score was assessed using Spearman's rank correlation coefficient. A p-value of less than 0.05 was considered statistically significant.

Ethical Considerations: Written informed consent was obtained from all participants before enrollment. Confidentiality of patient information was maintained throughout the study. Participation was entirely voluntary, and patients retained the right to withdraw at any stage without affecting their treatment. The study was conducted in accordance with the ethical principles of the Declaration of Helsinki applicable at the time of study conduct.

RESULTS

A total of 34 patients with symptomatic gallstone disease who underwent cholecystectomy during the study period were included in the analysis.

Among the 34 patients studied, females constituted the majority of cases, and most patients were between 31 and 50 years of age (Table 1)

Table 1. Demographic Characteristics of Study Participants (n = 34)

Variable	Category	Frequency (n)	Percentage (%)
Age (years)	18–30	8	23.5
	31–40	11	32.4
	41–50	9	26.5
	>50	6	17.6
Sex	Male	10	29.4
	Female	24	70.6

Gallbladder wall thickness greater than 3 mm was observed in approximately two-fifths of the study population, with a mean wall thickness of 3.4 $\pm$ 0.9 mm (Table 2).

Table 2. Ultrasonographic Findings: Gallbladder Wall Thickness (n = 34)

Gallbladder Wall Thickness (mm)	Frequency (n)	Percentage (%)
≤3 mm	20	58.8
>3 mm	14	41.2
Total	34	100

Mean gallbladder wall thickness: 3.4 ±0.9 mm

Intraoperatively, dense adhesions and difficult dissection of Calot's triangle were the most frequently encountered indicators of operative difficulty, whereas conversion to open surgery was uncommon (Table 3).

Table 3. Intraoperative Difficulty Parameters During Cholecystectomy (n = 34)

Parameter	Present n (%)	Absent n (%)
Dense adhesions around gallbladder	11 (32.4)	23 (67.6)
Difficult Calot's triangle dissection	10 (29.4)	24 (70.6)
Operative time >60 minutes	9 (26.5)	25 (73.5)
Excessive intraoperative bleeding	4 (11.8)	30 (88.2)
Conversion to open surgery	2 (5.9)	32 (94.1)

A statistically significant association was observed between increased gallbladder wall thickness and operative difficulty. Patients with gallbladder wall thickness greater than 3 mm experienced a substantially higher frequency of difficult surgery compared with those having wall thickness of 3 mm or less (Table 4).

Table 4. Association Between Gallbladder Wall Thickness and Operative Difficulty (n = 34)

Gallbladder Wall Thickness	Easy Surgery n (%)	Difficult Surgery n (%)	Total	p-value
≤3 mm (n=20)	17 (85.0)	3 (15.0)	20	
>3 mm (n=14)	5 (35.7)	9 (64.3)	14	
Total	22	12	34	0.006*

*Chi-square test; p < 0.05 considered statistically significant.

Furthermore, gallbladder wall thickness demonstrated a moderate positive correlation with operative difficulty score, indicating that increasing wall thickness was associated with greater operative challenges during cholecystectomy (Table 5).

Table 5. Correlation of Gallbladder Wall Thickness with Operative Difficulty Score (n = 34)

Variable	Spearman Correlation Coefficient (ρ)	p-value
Gallbladder wall thickness vs operative difficulty score	0.52	0.002*

*Statistically significant correlation.

DISCUSSION

The present observational analytical study evaluated the relationship between preoperative gallbladder wall thickness and operative difficulty during cholecystectomy in patients with symptomatic gallstone disease. The findings demonstrated a significant association between increased gallbladder wall thickness and operative difficulty. Patients with a gallbladder wall

thickness greater than 3 mm experienced a higher frequency of difficult surgeries, and a moderate positive correlation was observed between wall thickness and operative difficulty score. These findings suggest that gallbladder wall thickness, as assessed by routine preoperative ultrasonography, may serve as a useful predictor of technical challenges during cholecystectomy.

Gallstone disease remains one of the most common indications for abdominal surgery worldwide, and prediction of difficult cholecystectomy continues to be an important clinical objective. Preoperative identification of patients likely to experience operative difficulties allows better surgical planning, appropriate case allocation, informed patient counseling, and improved operating room management [2,4]. Among the various predictors studied, gallbladder wall thickness has emerged as a practical parameter because it can be assessed noninvasively during routine ultrasonographic evaluation [5]. In the present study, approximately 41% of patients demonstrated gallbladder wall thickening greater than 3 mm. This observation is consistent with the established understanding that recurrent inflammation associated with chronic cholecystitis results in edema, fibrosis, and thickening of the gallbladder wall [6]. Such pathological changes frequently lead to adhesion formation and distortion of normal anatomy, thereby increasing surgical complexity.

The significant association observed between increased gallbladder wall thickness and operative difficulty is consistent with previous reports. Fried et al. reported that inflammatory changes around the gallbladder were among the major factors contributing to technically demanding laparoscopic cholecystectomy and conversion to open surgery [8]. Similarly, Schrenk et al. identified gallbladder wall thickening as an important predictor of difficult operative dissection and prolonged operative duration [9]. The present findings support these observations and further reinforce the utility of ultrasonographic wall thickness measurement in preoperative risk assessment.

The relationship between gallbladder wall thickness and difficult dissection may be explained by the underlying pathological processes. Repeated episodes of inflammation can result in dense adhesions between the gallbladder and surrounding structures, obliteration of tissue planes, and fibrosis within Calot's triangle. These changes make identification of critical anatomical landmarks more difficult and may increase the risk of intraoperative bleeding or bile duct injury [6]. In the present study, dense adhesions and difficult Calot's triangle dissection were among the most frequently encountered intraoperative challenges, supporting this pathophysiological explanation.

The low conversion rate observed in this study is comparable to rates reported in contemporary surgical literature during the early laparoscopic era [8,11]. Although only a small number of patients required conversion to open surgery, both cases were associated with significant inflammatory changes and increased operative difficulty. Conversion should not be regarded as a complication but rather as a prudent surgical decision when safe laparoscopic dissection cannot be ensured [12].

Several investigators have attempted to develop predictive models incorporating clinical, laboratory, and ultrasonographic parameters. Brodsky et al. reported that ultrasonographic findings, particularly gallbladder wall thickening and contracted gallbladder morphology, were associated with increased operative complexity [13]. Likewise, Lal et al. demonstrated that preoperative sonographic parameters could assist in predicting difficult laparoscopic cholecystectomy in routine surgical practice [14]. The present study adds evidence from a Bihar tertiary care setting and supports the inclusion of gallbladder wall thickness in preoperative assessment protocols.

From a clinical perspective, the findings have practical implications. Gallbladder wall thickness measurement is inexpensive, readily available, and routinely performed during ultrasonography. Recognition of increased wall thickness may alert surgeons to the possibility of difficult dissection, facilitate appropriate scheduling of cases, ensure availability of experienced surgical personnel, and improve patient counseling regarding operative risks and possible conversion to open surgery.

The study possesses several strengths. First, all patients underwent standardized preoperative ultrasonographic evaluation and operative assessment within a single institution, reducing inter-center variability. Second, the study directly evaluated the correlation between a measurable radiological parameter and operative outcomes, enhancing clinical applicability. Third, the prospective collection of operative findings minimized recall bias.

However, certain limitations should be acknowledged. The sample size was relatively small and was limited by the study duration. The study was conducted at a single tertiary care center, which may restrict generalizability to other populations. Operative difficulty was assessed using intraoperative criteria that may contain some degree of subjective judgment despite predefined definitions. Furthermore, additional predictors such as body mass index, previous abdominal surgery, and biochemical inflammatory markers were not evaluated in a multivariable model. Larger multicentric studies are required to validate these findings and establish standardized predictive scoring systems for difficult cholecystectomy. Overall, the results indicate that increased gallbladder wall thickness is significantly associated with greater operative difficulty during cholecystectomy and may serve as a valuable preoperative predictor in routine surgical practice.

CONCLUSION

The present study demonstrated a significant association between preoperative gallbladder wall thickness and operative difficulty during cholecystectomy. Patients with gallbladder wall thickness greater than 3 mm were more likely to experience difficult surgical procedures characterized by dense adhesions, challenging dissection of Calot's triangle, prolonged operative time, and an increased likelihood of conversion to open surgery. Furthermore, a moderate positive correlation was observed between gallbladder wall thickness and operative difficulty score. These findings indicate that ultrasonographic assessment of gallbladder wall thickness is a simple, non-invasive, and readily available tool that can assist in preoperative prediction of operative difficulty. Incorporating this parameter into routine preoperative evaluation may facilitate better surgical planning, appropriate allocation of operative resources, and more effective patient counseling regarding potential intraoperative challenges. Further studies involving larger sample sizes and multicentric populations are recommended to validate these findings and develop comprehensive predictive models for difficult cholecystectomy.

DECLARATIONS

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Conflict of Interest: The authors declare that there are no conflicts of interest.

Informed Consent: Written informed consent was obtained from all participants before enrollment in the study.

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