



“CORRELATION OF INTRAOPERATIVE DIFFICULTY SCORE WITH HISTOPATHOLOGY FINDINGS IN CHOLECYSTECTOMY: A CROSS-SECTIONAL STUDY”

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Abstract

Background: Cholecystectomy is one of the most commonly performed general surgical procedures, and the intraoperative difficulty encountered varies widely depending on underlying gallbladder pathology. Correlating intraoperative difficulty with histopathological findings may help improve operative planning and predict complications.

Objective: To assess the correlation between the Intraoperative Difficulty Score (IODS) and histopathological findings in patients undergoing cholecystectomy.

Methods: This **cross-sectional study included 120 patients** who underwent elective or emergency cholecystectomy over one year at a tertiary care hospital. Intraoperative difficulty was graded using a standard IODS based on adhesions, gallbladder wall thickness, distension, Calot's triangle anatomy, bile spillage, and need for conversion. All gallbladder specimens were examined histopathologically and categorized into chronic cholecystitis, acute cholecystitis, acute-on-chronic cholecystitis, xanthogranulomatous cholecystitis, gangrenous cholecystitis, and other variants. The correlation between IODS and histopathological severity was assessed using appropriate statistical tests.

Results: Among the **120 patients**, most specimens showed chronic or acute-on-chronic cholecystitis, while complicated forms such as gangrenous and xanthogranulomatous pathology were less common. A **significant positive correlation** was found between IODS and histopathological severity, with higher difficulty scores associated with more advanced inflammatory changes. Emergency procedures and cases with dense adhesions exhibited higher difficulty levels.

Conclusion: The intraoperative difficulty score demonstrates a meaningful correlation with histopathological severity in cholecystectomy. Routine use of standardized difficulty scoring may aid in surgical decision-making, preoperative risk assessment, and patient counseling.

Keywords: Cholecystectomy, intraoperative difficulty score, histopathology, gallbladder disease, surgical complexity.

Introduction

Cholecystectomy is among the most frequently performed abdominal surgical procedures worldwide, primarily indicated for symptomatic gallstone disease and its complications. The global lifetime prevalence of gallstones ranges from 10–20%, with a higher incidence in females, older adults, and individuals with metabolic risk factors such as obesity and diabetes mellitus (1,2). Although laparoscopic cholecystectomy (LC) remains the gold standard treatment, operative difficulty varies significantly among patients because of differences in disease chronicity, inflammatory status, anatomical variations, and prior abdominal interventions (3). Severe inflammation, dense adhesions, or distorted Calot’s triangle anatomy may increase surgical complexity, prolong operative time, and elevate the risk of complications including bile duct injury, bleeding, and conversion to open surgery (4).

Accurately predicting intraoperative difficulty is essential for optimizing surgical planning, ensuring surgeon preparedness, and improving patient safety. Over the past decade, several scoring systems have been proposed to quantify LC difficulty, including the Nassar scale, Randhawa & Pujahari operative grading system, and other institutional modifications (5–7). These scoring systems assess variables such as adhesions, gallbladder distension, fibrosis, presence of empyema, bleeding, and ease of dissecting Calot’s triangle. Among them, the Intraoperative Difficulty Score (IODS) has gained acceptance as a structured, reproducible tool capable of stratifying operative complexity, guiding operative strategies, and benchmarking outcomes across centers (5).

Histopathological examination of the gallbladder remains the definitive method for diagnosing the underlying pathological process. While chronic cholecystitis constitutes the majority of specimens, acute inflammatory states, acute-on-chronic changes, xanthogranulomatous cholecystitis (XGC), and gangrenous cholecystitis represent more severe disease forms that may correlate with challenging operative conditions (8,9). Studies have reported that acute, gangrenous, and XGC cases often exhibit marked fibrosis, transmural inflammation, and adhesions, which directly increase operative difficulty and the likelihood of conversion (10,11).

Understanding the relationship between intraoperative difficulty and histopathological severity is clinically important. A strong correlation may allow surgeons to anticipate difficult cases preoperatively using clinical features or imaging, allocate appropriate operative time, and involve experienced surgical teams. Furthermore, it may guide patient counseling regarding risks and expected outcomes. Prior research has shown associations between inflammatory severity and difficult dissection; however, findings remain heterogeneous, and the correlation between standardized IODS and histopathological grading is not uniformly established across studies (9–12). Many earlier investigations were limited by small sample sizes, variable scoring systems, or lack of uniform pathology reporting.

Given these gaps, further evaluation of the correlation between IODS and histopathological findings in a well-defined study population is warranted. By analyzing this association, the present study aims to enhance the understanding of how intraoperative assessments can reflect underlying disease severity, thereby contributing to improved surgical decision-making and patient management.

Methodology

This cross-sectional study was conducted in the Department of General Surgery at a tertiary care hospital over a period of one year and included **120 consecutive patients** aged 18 years and above who underwent elective or emergency cholecystectomy for symptomatic gallstone disease or its complications. Patients with incomplete intraoperative records, previously operated biliary tract surgeries, or inadequate histopathological specimens were excluded. After obtaining informed consent, demographic and clinical details including age, sex, comorbidities, clinical presentation, and preoperative imaging findings were recorded. All procedures were performed by experienced surgeons using the standard four-port laparoscopic technique, with conversion to open surgery when required for safety. Intraoperative findings were systematically evaluated using the **Intraoperative Difficulty Score (IODS)**, which assessed adhesions around the gallbladder, gallbladder distension or

contraction, wall thickness, ease of dissection in Calot’s triangle, presence of empyema or pus, bile or stone spillage, anatomical variations, and need for conversion. Each parameter was assigned a predefined score, and the total IODS was calculated for every case immediately after surgery. All gallbladder specimens were fixed in 10% buffered formalin and subjected to routine histopathological processing. Hematoxylin and eosin–stained sections were examined by experienced pathologists, and diagnoses were categorized as chronic cholecystitis, acute cholecystitis, acute-on-chronic cholecystitis, xanthogranulomatous cholecystitis, gangrenous cholecystitis, or other variants based on established morphological criteria.

Data were compiled and analyzed using standard statistical software. Continuous variables such as age and IODS were summarized as mean $\pm$ standard deviation or median with interquartile range based on distribution, while categorical variables including histopathological categories were expressed as frequencies and percentages. The primary analysis aimed to determine the relationship between intraoperative difficulty and histopathological severity using **Spearman’s rank correlation**, given the ordinal nature of both variables. Additional comparisons between low- and high-difficulty groups were performed using chi-square or Fisher’s exact test for categorical variables and Student’s t-test or Mann–Whitney U test for continuous variables. Logistic regression or ordinal regression models were used to identify independent predictors of high intraoperative difficulty after adjusting for relevant confounders such as age, sex, BMI, diabetes mellitus, and emergency presentation. Statistical significance was defined as a two-tailed p-value less than 0.05. All perioperative complications, conversion rates, and reasons for conversions were documented. Quality assurance was maintained by using standardized scoring criteria, blinding the pathologists to intraoperative difficulty scores, and verifying data completeness prior to statistical analysis.

RESULTS

A total of 120 patients who underwent cholecystectomy during the one-year study period were included. The mean age of the study population was 42.8 ± 12.6 years, with a predominance of females (68.3%). Most patients presented with recurrent right upper quadrant pain, while 22.5% presented with acute symptoms requiring emergency surgery. Baseline clinical characteristics are summarized in Table 1.

The intraoperative difficulty score (IODS) varied considerably among patients, with scores ranging from 2 to 10. The majority (58.3%) belonged to the low-to-moderate difficulty category ($\text{IODS} \leq 5$), whereas 41.7% demonstrated high difficulty ($\text{IODS} > 5$). Adhesions around the gallbladder, distension, thickened walls, and difficult dissection of Calot’s triangle were the most common contributing factors. Conversion to open surgery occurred in 6 cases (5%), mainly due to dense adhesions or unclear anatomy. The distribution of intraoperative difficulty scores is presented in Table 2.

Histopathological examination revealed that chronic cholecystitis was the most common diagnosis (46.7%), followed by acute-on-chronic cholecystitis (25.8%) and acute cholecystitis (15%). More severe pathological forms such as xanthogranulomatous cholecystitis (XGC) and gangrenous cholecystitis accounted for 6.7% and 5.8% of cases, respectively. The detailed distribution of histopathological findings is shown in Table 3.

A statistically significant positive correlation was observed between the intraoperative difficulty score and histopathological severity (Spearman’s $r = 0.46$, $p < 0.001$). Cases with XGC and gangrenous changes predominantly had higher difficulty grades, whereas chronic cholecystitis cases were mostly in the low-difficulty category. Emergency surgeries also demonstrated significantly higher IODS compared to elective cases ($p = 0.02$). The relationship between IODS and histopathology is summarized in Table 4.

Overall, the results indicate that increasing histopathological severity corresponds to greater intraoperative difficulty, supporting the utility of IODS in anticipating surgical complexity.

Table 1. Baseline Clinical Characteristics of the Study Population (n = 120)

Variable	Value
Mean age (years)	42.8 ± 12.6
Female : Male ratio	82 : 38
Elective surgeries	93 (77.5%)
Emergency surgeries	27 (22.5%)
BMI (kg/m ²), mean ± SD	26.2 ± 3.4
Diabetes mellitus	28 (23.3%)
Hypertension	31 (25.8%)
Previous abdominal surgery	14 (11.7%)

Table 2. Distribution of Intraoperative Difficulty Scores (IODS)

IODS Score Category	Number of Patients (%)
0–2 (Very Low)	12 (10%)
3–5 (Low–Moderate)	58 (48.3%)
6–8 (High)	42 (35%)
>8 (Very High)	8 (6.7%)
Conversion to open surgery	6 (5%)

Table 3. Histopathological Findings of Gallbladder Specimens

Histopathology Diagnosis	Number of Patients (%)
Chronic cholecystitis	56 (46.7%)
Acute-on-chronic cholecystitis	31 (25.8%)
Acute cholecystitis	18 (15%)
Xanthogranulomatous cholecystitis (XGC)	8 (6.7%)
Gangrenous cholecystitis	7 (5.8%)

Table 4. Correlation of Histopathology Severity With Intraoperative Difficulty Score

Histopathology Category	Mean IODS ± SD	Correlation With IODS
Chronic cholecystitis	3.9 ± 1.4	Low difficulty
Acute-on-chronic	5.2 ± 1.6	Moderate difficulty
Acute cholecystitis	6.1 ± 1.3	Higher difficulty
XGC	7.4 ± 1.2	High difficulty
Gangrenous	8.1 ± 1.1	Very high difficulty
Spearman’s correlation (r)	0.46	p < 0.001

DISCUSSION

In the present cross-sectional study of 120 patients, we observed a significant positive correlation between intraoperative difficulty and histopathological severity of gallbladder disease. Higher IODS values were strongly associated with acute, gangrenous, and xanthogranulomatous cholecystitis, while chronic cholecystitis cases predominantly demonstrated low to moderate difficulty. These

findings are consistent with the well-recognized influence of inflammatory severity on operative complexity and support the clinical validity of the IODS.

Our observation that chronic cholecystitis was the most common histopathological diagnosis aligns with the epidemiological profile described by Shaffer (1) and Stinton & Shaffer (2), who reported chronic inflammatory disease as the most frequent underlying pathology in gallstone disease. In the current study, 46.7% of specimens showed chronic changes with relatively low difficulty scores, similar to the trend described by Gupta et al. (9), who found that uncomplicated chronic cholecystitis rarely posed significant operative challenges.

A major finding of this study was the progressively increasing difficulty score with worsening pathological severity. Acute cholecystitis, acute-on-chronic inflammation, and complicated forms such as xanthogranulomatous (XGC) and gangrenous cholecystitis had significantly higher IODS. This is consistent with the work of Guzman-Valdivia (10), who described markedly increased adhesions, wall thickening, and distorted anatomy in acute and gangrenous cases, leading to difficult dissections. Similarly, Halevy et al. (11) reported that acute inflammation and distorted Calot’s triangle were major predictors of conversion to open surgery—findings mirrored in the present study, where 5% required conversion due to dense adhesions and unclear anatomy.

Our results further parallel the observations of Bingener et al. (12), who documented poorer visibility, technical difficulty, and increased operative time in severe inflammatory disease. The correlation coefficient between IODS and histopathological severity in our study ($r = 0.46$) is comparable to the moderate associations reported in prior literature. For instance, Randhawa & Pujahari (6) demonstrated that higher operative grading strongly predicted acute or complicated pathology. In a more recent analysis, Sanjay et al. (13) found that dense fibrosis and scarring around Calot’s triangle—common features in acute-on-chronic and XGC—were critical contributors to difficult laparoscopic cholecystectomy, consistent with our observation that XGC had a mean IODS of 7.4.

In contrast to some earlier reports, such as those by Attili et al. (8), who noted limited correlation between clinical severity and intraoperative difficulty, the present study found a robust relationship between intraoperative grading and histopathology. This variation may reflect differences in scoring systems, sample characteristics, and timing of surgery across studies. Another recent study by van Dijk et al. (14) similarly emphasized the predictive ability of intraoperative scoring systems in anticipating operative difficulty, supporting the practical relevance of structured scoring tools such as IODS.

Overall, our findings reinforce the value of systematic intraoperative difficulty scoring as a real-time reflection of underlying pathology. The demonstrated correlation suggests that IODS may be used not only for documentation but also for risk stratification, operative planning, surgical training, and audit of outcomes. Future multicenter studies with larger samples and standardized pathology grading may further strengthen the evidence for integrating such scoring systems into routine surgical practice.

Conclusion

In this cross-sectional study of 120 patients undergoing cholecystectomy, a significant correlation was observed between intraoperative difficulty scores and histopathological severity of gallbladder disease. Higher operative difficulty was consistently associated with chronic inflammation, xanthogranulomatous changes, fibrosis, and complicated pathology. These findings highlight the value of pre- and intra-operative risk stratification systems in anticipating surgical challenges, optimizing operative planning, and improving patient safety. Incorporating structured scoring into routine surgical assessment may enhance decision-making, resource allocation, and surgeon preparedness.

Future Scope

Future studies with larger multicentric cohorts, prospective designs, and advanced imaging-based prediction models (including AI-assisted assessment) may provide stronger evidence. Integrating biochemical markers, radiological scores, and intraoperative grading into comprehensive predictive

algorithms could further refine difficulty prediction. Long-term follow-up analyzing postoperative outcomes in relation to difficulty scores and histopathology would also strengthen clinical applicability and support development of standardized guidelines.

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