Assessing the Role of Gallbladder Wall Thickness in Cholecystectomy: Surgical Considerations and Patient Outcomes - A Prospective Study

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Abstract: *Laparoscopic cholecystectomy has become the primary procedure for the majority of patients with benign gallbladder disease. The main objective of this study was to investigate the impact of gallbladder wall thickness on the outcomes of cholecystectomy, along with any associated intra or postoperative complications. This prospective clinical trial was conducted on patients undergoing cholecystectomy, either by open or laparoscopic method, at a single surgical unit in M. B. Govt. Hospital, Udaipur, during the period between January2023 and June2023. Before the cholecystectomy procedure, abdominal sonography was performed on all 50 patients. The surgeon re - confirmed the sonography findings in the operating room. Among the patients with cholecystolithiasis, 27 cases (54 %) underwent a straightforward and normal cholecystectomy, while the remaining 23 cases (46%) encountered difficult cholecystectomy.*

Keywords: cholecystectomy, Gall bladder wall thickness, management.

1. Introduction

There are many reasons to predict a potentially complicated cholecystectomy in a dynamic clinical setting. It is crucial to know if a patient is a candidate for a one - day outpatient procedure or if they need to be treated with an inpatient procedure. Additionally, the appropriate time and procedure length must be determined to avoid overloading the hospital's infrastructure. The patient and the surgical team must be prepared for a possible conversion and the trainees or senior surgeons must consent to perform the procedure. The increased gallbladder wall thickness (GBWT) can negatively impact the outcome of a cholecystectomy. GBWT is an independent factor associated with complex surgeries and is included in many predicting preoperative scores. The wall thickness of gallbladder is an indicator of cholecystitis in patients who have presented with symptoms of gallstone disease.[1] The gallbladder wall is normally measured less than 3mm by ultrasonography (USG).[2] Gallbladder wall thickness measurement is accurate to within 1 mm in 93% of patients by USG.[3] A thickness of the gallbladder wall of more than 3 mm is suggestive of cholecystitis.[4] Despite the fact that this is also found in many conditions like gallbladder cancer and adenomyomatosis, it is the hallmark of cholecystitis, but in these conditions, the diameter of the gallbladder is directly part of the underlying pathology.[5] For laparoscopic cholecystectomy, the prediction of conversion and complications are quite important for the management of gallstone disease.[6] Gallbladder wall thickness is one of the major factors in determining the type of surgical procedure for the management of gallstone disease. The aim of this study was to evaluate the impact of gallbladder wall thickness on surgical management in patients undergoing cholecystectomy.

Patients and Methods
The research was carried out on patients who were undergoing cholecystectomy, either through open surgery or laparoscopic method, at a single surgical unit in M. B. Govt. Hospital, Udaipur. In this prospective study, all patients undergoing cholecystectomy were included, regardless of their age, sex, physique, or parity. This prospective study encompassed all patients undergoing cholecystectomy, where the indication for the procedure varied based on the specific pathology necessitating cholecystectomy alone, such as gallstone disease. Additionally, cholecystectomy was performed as an adjunct procedure for other surgical interventions like Whipple's procedure or choledochal cyst excision.

The following parameters were observed and recorded for each patient:
1) Detailed patient history with a special focus on symptoms of biliary colic, previous colic attacks, jaundice, and history suggesting pancreatitis.
2) History of comorbid conditions, including diabetes mellitus (DM), hypertension (HT), significant illnesses, and previous symptoms.
3) General physical examination.
4) Abdominal examination.
5) Routine investigations, including complete blood count (CBC), bleeding time (BT), clotting time (CT), prothrombin time (PT), international normalized ratio (INR), human immunodeficiency virus (HIV) status, hepatitis B surface antigen (HBsAg), blood urea, serum creatinine, and blood sugar levels.
6) Findings from specific investigations, such as abdominal Ultrasonography (USG), Magnetic Resonance Imaging (MRI), Magnetic Resonance Cholangiopancreatography (MRCP), Liver Function Tests (LFTs), and Histopathological Examination (HPE) were noted. Not all patients underwent certain imaging studies like Contrast - Enhanced Computed Tomography (CECT) or MRI/MRCP.
7) Intraoperative findings, including gall bladder wall thickness, number of stones, presence of empyema gall

bladder, adhesions, Calot's triangle anatomy, cut section appearance, level of difficulty during the surgery, and the duration of each procedure. The recorded time started just after insertion of the three parts and continued until the removal of all ports, excluding the time of insertion and closure of port sites.

8) Postoperative morbidity and mortality rates were also noted. It's essential to gather such comprehensive data to analyze and understand various aspects of cholecystectomy outcomes in the study population.

Histomorphological study
The study involved a histomorphological examination of recently obtained tissue samples using the standard light microscopic method.

Gallbladder wall thickness measurement:
The gall bladder wall thickness was measured using a precise dissecting method. A sharp B - P blade was used to create a longitudinal incision along the peritoneal smooth surface of the gall bladder from its fundus to the neck. The interior of the gall bladder was then cleaned using jets of tap water. Subsequently, the gall bladder wall thickness was measured in millimeters (mm) at 3 - 5 different locations using a digital slide caliper, and the highest recorded value was included in the study. The non - peritoneal surface was
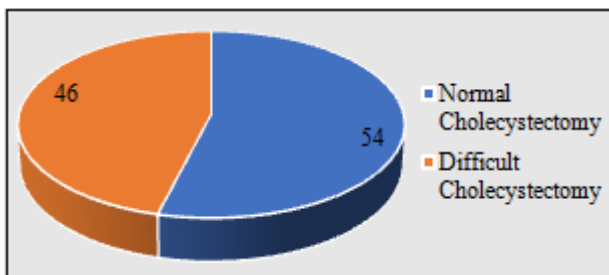
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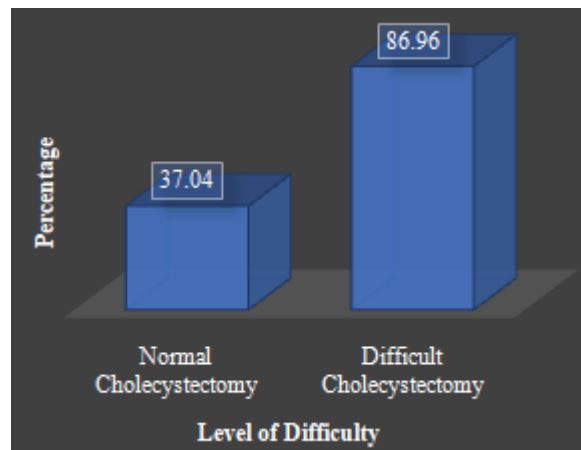
2. Result and Discussion

Among the 48 patients diagnosed with gall bladder disease, 27 individuals (54%) underwent a routine and uncomplicated cholecystectomy procedure. Within this group, 21 patients (77.78%) had a normal gall bladder wall thickness, while 6 patients (22.22%) presented with a thickened gall bladder wall. In 10 cases (37.04 %), some adhesions were encountered during the surgery, but they were managed with ease and effectively separated from the gall bladder. Fortunately, no significant postoperative complications were reported, and the most common issue observed was mild abdominal pain, primarily localized at the wound sites. For selected cases, a subhepatic tube drain was employed in only six patients, and it was efficiently removed on the following day, with minimal blood drainage. The duration of the cholecystectomy procedure varied between 25 to 40 minutes. Overall, the study demonstrated favorable outcomes for the majority of patients who underwent cholecystectomy, with relatively low postoperative complications and satisfactory surgical efficiency.

Table 1: Predictors & value of findings for patients undergoing cholecystectomy
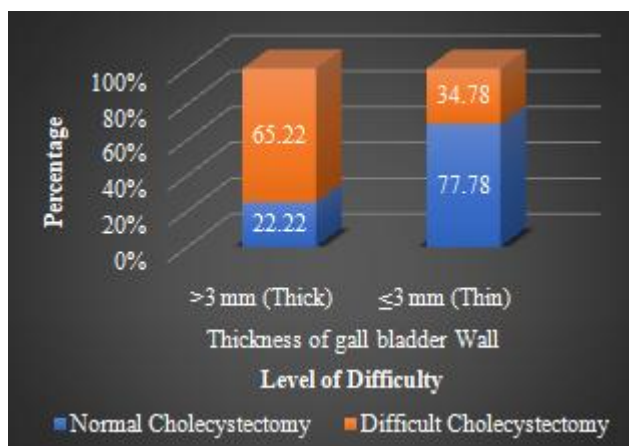
Level of Difficulty	Number of patients	Laparoscopic/Open Cholecystectomy		Thickness of gall bladder Wall		Presence of adhesions	Requirement of drain	Duration of operation (in min)
		Lap	Open	>3 mm (Thick)	≤3 mm (Thin)			
Normal	27	15	12	6	21	10	7	25 - 40
Difficult	23	9	14	15	8	20	13	>40

Figure 1: Percentage of different type of operations

Figure 2: Percentage of gall bladder wall thickness in different operations

Figure 3: Presence of adhesions around gall bladder in different types of operations

During cholecystectomy, difficulties were encountered in 23 cases (46%) of which 34.78 % had a normal gall bladder wall thickness, while 65.22% had thickened gall bladders. The determination of difficulty during cholecystectomy was based on several operative parameters, including the duration of surgery, bleeding, dissection of Calot's triangle, dissection of the gall bladder wall, presence of adhesions, and the difficulty of gall bladder extraction. These factors were considered to assess the challenges faced during the surgical procedure.

During the "difficult" cholecystectomy procedures, we encountered adhesions in 86.96% of cases. These adhesions

were dense and presented challenges in separating the gall bladder from nearby structures, requiring careful and time - consuming dissection to ensure a safe operative field. In 13 patients, we used a suphepatic tube drain, and all drains were removed within 24 hours following the surgery. The duration of a "difficult" cholecystectomy exceeded 40 minutes.

One significant predictor of difficulties during cholecystectomy was the thickness of the gall bladder wall. Among patients with gall bladder wall thickness greater than 3 millimeters, we faced such challenges in 20 cases. These findings align with a study conducted by Ali Dawood[7] confirming the importance of gall bladder wall thickness as a potential factor contributing to surgical difficulties. Overall, our observations highlighted the impact of gall bladder wall thickness and adhesions on the complexity of cholecystectomy procedures, emphasizing the need for meticulous dissection and careful management of dense adhesions to ensure successful outcomes.

In all the histopathological examinations of the gall bladder, chronic inflammation was the prevailing finding, except for one case of malignancy and another case of acute or chronic cholecystitis. The study conducted by Wibbenmeyer et al.[8] (1995) revealed that incidental findings of gall bladder carcinoma were reported in only 1% of cholecystectomies performed for cholelithiasis. Thus, the vast majority of cases showed chronic inflammation in the gall bladder, aligning with the common presentation of cholecystitis, while the incidence of gall bladder carcinoma discovered incidentally during cholecystectomy for cholelithiasis was relatively low according to the mentioned study.

Currently, laparoscopic cholecystectomy is regarded as the gold standard for treating symptomatic gall stones. However, it is important to note that this procedure is technically more challenging than the traditional open cholecystectomy, especially in cases of difficult cholecystectomy.[9, 10, 11] While laparoscopic cholecystectomy offers numerous benefits such as smaller incisions, reduced postoperative pain, and quicker recovery, it requires advanced surgical skills and expertise due to the limited visualization and precise maneuvering required in the laparoscopic approach. Therefore, the decision to perform laparoscopic cholecystectomy should be carefully considered, particularly in cases where the surgical procedure may be more complex or challenging.

The primary objective of the study was to assess the influence of gallbladder wall thickness on the outcomes of cholecystectomy. Specifically, the researchers aimed to understand how the thickness of the gallbladder wall could affect the surgical procedure and its overall success. Additionally, the study sought to identify and evaluate any potential intraoperative or postoperative complications associated with gallbladder wall thickness during cholecystectomy. By examining these factors, the researchers aimed to gain valuable insights into the impact of this specific parameter on the surgical outcomes and patient well - being.

Our study findings indicate that gall bladder wall thickening can serve as a reliable predictor of difficulties during cholecystectomy. Specifically, we observed that patients

with thickened gall bladder walls were more likely to encounter operative challenges, corroborating the observations made by European surgeons. They also reported that a thickened gall bladder wall was linked to technically demanding surgeries and prolonged operation times. Moreover, the outcomes of our study align with those reported by Corr,[9] who also found a significant association between gall bladder wall thickness and operative difficulty. This concurrence between our study and previous research further emphasizes the importance of considering gall bladder wall thickness as a crucial factor in predicting potential challenges during cholecystectomy. Identifying this parameter preoperatively can help surgeons prepare for and manage technical complexities, thereby enhancing patient care and surgical outcomes.

Informing patients about the possibility of complications and the potential need for conversion to an open procedure can significantly benefit them. By being aware of these possibilities, patients can mentally prepare themselves and adjust their expectations accordingly. Furthermore, surgeons can make more informed decisions, and in cases where difficult surgery is expected, they can directly perform a classical open cholecystectomy, saving operating time and reducing the conversion rate.

A study conducted by Fuchs[12] revealed that laparoscopy might even be advantageous for patients who are considered difficult to operate on. While conversion to laparotomy itself does not worsen patient outcomes, there are several reasons to support preoperative assessment of the feasibility of laparoscopy. Having an idea about the individual patient's risk when obtaining informed consent is crucial. Additionally, cost efficiency considerations should be taken into account, as the equipment for an unsuccessful laparoscopy can be expensive. Identifying potential difficulties in advance is especially important in teaching hospitals where open cholecystectomy has become a rare procedure[13] and requires the expertise of experienced surgeons. Being proactive in assessing the feasibility of laparoscopy can lead to better patient care, enhanced cost - effectiveness, and more efficient utilization of resources in surgical settings.

In a study conducted by Khan et al.[14], operative time and postoperative length of stay were evaluated as criteria, which were also considered in the present study. The group with normal gallbladder wall thickness exhibited the lowest mean operative time, approximately 52.97 minutes with a standard deviation (SD) of 9.27 minutes. As the gallbladder wall thickness increased, the mean operative time also increased, consistent with findings in the existing literature.[15]

Additionally, postoperative length of stay was measured as an outcome after surgery. Among patients with normal gallbladder wall thickness, the mean postoperative length of stay was the shortest, approximately 2.8 days with an SD of 1.45 days. In contrast, the severely thickened gallbladder group had the longest postoperative length of stay, averaging around 11 days with an SD of 10.12 days. Factors contributing to the increased length of stay were postoperative bile leak, postoperative pain, and surgical site infection. The observed postoperative length of stay was

slightly higher than what has been reported in the literature.[15] These findings highlight the importance of gallbladder wall thickness as a predictor for operative time and postoperative outcomes, with thicker gallbladder walls being associated with longer operative durations and extended hospital stays due to complications such as bile leak, pain, and infection.

In a study conducted by Shagor et al.[16], the reported range of gall bladder wall thickness in patients was found to be between 0.3 to 12% in previous research papers.[17] In their own study, the average gall bladder wall thickness for all patients was 7.50 ± 2.23 mm, ranging from 4 to 13 mm. The majority of patients exhibited a moderate gall bladder wall thickness (8 - 10 mm, 52.7%), followed by mild thickness (4 - 7 mm, 37.3%), and a smaller percentage had severe thickness (>10 mm, 10%). Patients with gall bladder carcinoma had significantly thicker gall bladder walls (average 9.80 mm) compared to those without GB carcinoma (average 6.93 mm), and they also showed a higher frequency of severe gall bladder wall thickness (36.36% vs.3.41%). By employing multivariate logistic regression analysis and adjusting for age, gender, and positive smoking history, the researchers found that gall bladder wall thickness ≥8.25 mm had the highest significant odds ratio for predicting gall bladder carcinoma (OR=13.32, 95% CI=3.43 - 51.78, p - value<0.001). This relationship between thicker gall bladder wall and gall bladder carcinoma was also observed in previous studies.[18]

Overall, the findings of Shagor et al. 's study highlight the significance of gall bladder wall thickness as a potential predictor for gall bladder carcinoma, with thicker walls being associated with a higher likelihood of developing this condition. The research emphasizes the importance of considering gall bladder wall thickness as a relevant diagnostic factor in clinical assessments and evaluations for possible malignancies.

Jantsch[19] (1987) reported that a gall bladder wall thickness exceeding 4 mm is often indicative of acute cholecystitis. In their study, 84% of patients with gall bladder wall thickening greater than 4 mm experienced surgical difficulties. Similarly, Gai and Thiele[20] (1992) reported similar findings.

In our own study, we found that a gall bladder wall thickness of more than 3 mm was significantly associated with challenging surgical preparations and histopathological evidence of chronic inflammation. The presence of inflammation in the gall bladder wall can render it friable, and the enlarged vessels are more prone to bleeding, compromising visibility and orientation during surgery. In such cases, surgeons may have to alter their operative approach to achieve better exposure. Additionally, thickening of the gall bladder wall beyond 3 mm, related to ongoing acute inflammation and inflammatory infiltration in the neck and Calot's triangle, are significant factors contributing to surgical difficulties during cholecystectomy.2[1, 22, 23] These findings emphasize the importance of considering gall bladder wall thickness and the presence of inflammation when assessing the complexity of cholecystectomy procedures. Understanding these factors can aid in anticipating potential difficulties and enable surgeons to plan appropriate strategies for a successful operation.

Difficulty during cholecystectomy has been associated with various negative outcomes, including prolonged operative time, increased use of anesthetics, higher overall morbidity, elevated rates of infective complications, longer recovery periods, extended hospital stays, greater costs, and increased patient dissatisfaction.2[4, 25]Considering these implications, the ability to accurately predict preoperatively the technical challenges that may arise during surgery becomes crucial in choosing between laparoscopic and open approaches.

In conclusion, having a reliable preoperative or intraoperative diagnostic tool is essential for planned gall bladder surgery. Such information enables surgeons to select the most appropriate surgical approach and avoid intraoperative difficulties. Based on our study findings, it is evident that gall bladder wall thickening serves as the most reliable predictor for difficulty during cholecystectomy. By identifying this factor preoperatively, surgical teams can make informed decisions, better plan the procedure, and optimize patient outcomes, ultimately leading to improved patient satisfaction and reduced postoperative complications.

Currently, laparoscopic cholecystectomy is considered the gold standard for treating symptomatic gallstones. However, it is acknowledged that this procedure can be more technically demanding, especially in cases of difficult cholecystectomy. The primary objective of this study was to identify reliable preoperative factors that could predict the difficulty level during cholecystectomy. Gall bladder wall thickness emerged as a significant predictor of difficulties during the cholecystectomy procedure. In our study, we encountered such difficulties in 20 patients with gall bladder wall thickness greater than 3 millimeters. The findings demonstrate a strong correlation between gall bladder wall thickness and the complexity of cholecystectomy procedures. These results underscore the importance of considering gall bladder wall thickness in preoperative assessments to anticipate potential challenges and prepare accordingly for the surgery. By identifying this predictive factor, surgeons can better plan the procedure, choose the most suitable approach, and optimize patient outcomes, ultimately leading to more successful cholecystectomy outcomes.

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