

Role of Ultrasonography (USG) in Evaluation of Pericholecystic Adhesions in Gallstone Disease (GSD).

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ABSTRACT

Background: In the recent era of laparoscopic and robotic surgeries, preoperative imaging has become very crucial in selecting the right operative technique in any pathological condition. Though laparoscopic cholecystectomy is widely accepted and practiced surgical technique yet it has limitations especially dense pericholecystic adhesions where the surgeon requires larger field of view for optimal dissection of gall bladder bed and for optimal control of bleeding. Though ultrasonography has been in wide use for preoperative evaluation of gall bladder stone disease yet very few studies have been conducted to evaluate its role in predicting pericholecystic adhesions responsible for difficult laparoscopic cholecystectomy. Prior knowledge of dense pericholecystic adhesions may help the surgeon in opting for open over laparoscopic cholecystectomy. **Methods:** Out of 70 patients with gall bladder stone disease that were enrolled in the study, complete data could be obtained in only 55 patients. All patients included in the study underwent ultrasonography of abdomen in fasting state and findings were recorded including pericholecystic adhesions & visualisation of Calot's triangle. The ultrasonographic findings were compared with that of the operative findings. **Results:** Our study revealed that ultrasonography has more than 70% sensitivity, more than 80% specificity and more than 76% accuracy in predicting pericholecystic adhesions which is the major cause of conversion from laparoscopic to open cholecystectomy. **Conclusions:** Ultrasonography can serve as an inexpensive imaging tool for predicting difficult laparoscopic cholecystectomy in patients with gall bladder stone disease by demonstrating signs of pericholecystic adhesions and nonvisualisation of normal-appearing Calot's triangle.

Keywords: Laparoscopic cholecystectomy, pericholecystic adhesions, ultrasonography.

INTRODUCTION

Superior quality preoperative imaging evaluation is very important for optimal management of biliary tract pathology such as cholelithiasis with and without cholecystitis. An initial assessment of pericholecystic area is helpful for early identification of factors which might complicate the surgery such as pericholecystic adhesions, anatomical variations in the biliary tract, unclear anatomy of Calot's triangle, etc.

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This will aid the surgeon to optimally manage the patient via laparoscopy or open surgery. Laparoscopic cholecystectomy is considered the standard of care for the management of symptomatic gallstones in appropriate clinical settings.^[1] Up to 80

to 90 per cent of all cholecystectomy is performed by laparoscopic technique in some hospitals.^[2] While the procedure is technically more demanding than the classical open cholecystectomy, especially in difficult cases, it has significant advantages for the patient in terms of a shorter hospital stay, fewer risks, minimal scar and a reduced risk of later complications.

Many challenges may however, complicate the laparoscopic procedure and lead to intraoperative difficulties. At times, the laparoscopic cholecystectomy (LC) may need conversion to an open cholecystectomy (OC) leading to increased risk and duration of surgery as well as anesthesia. Intraoperative problems such as pericholecystic adhesions, unclear anatomy of the Calot's triangle, unexpected bleeding during gallbladder (GB) removal, viscus perforation, difficulty in retrieval of GB through the port can pose difficulty in LC. Many of these challenges can be easily predicted, and consequently managed, with a good preoperative imaging evaluation.

The initial & usual imaging evaluation prior to LC is ultrasonography (USG) of hepato-pancreato-biliary region. It offers high sensitivity in primary detection of GB stones with high speed and portability.^[3] Though magnetic resonance imaging (MRI) is considered as gold standard for preoperative assessment because of superior soft tissue resolution and better delineation of pathology yet it is often used as a problem-solving tool due to its high cost and limited availability. USG parameters such as wall thickness of the GB, mobility of gallstone, distension and presence of pericholecystic fluid or wall edema are parameters helpful in assessing GB pathologies. In cases of active cholecystitis, several findings may be present on USG. Wall thickening of >4mm, distension of gall bladder, fluid around or in GB fossa region, air in wall of gall bladder and presence of an ultrasonographic Murphy's sign, all are important in decision of management of patient. Gallbladder wall thickness more than 3 mm can pose problems for laparoscopic cholecystectomy. Impaction of stone at neck of GB would cause difficulty in removal through laparoscopy port. Contracted GB and presence of pericholecystic fluid / edema signify that pathology will not be optimally cleared via laparoscopic approach. Whenever visualization of anatomy is not clear, the surgeon may decide to switch to an open cholecystectomy from a laparoscopic one. Impaired visualization may be caused by presence of dense adhesions on GB, excessive fluids extra or intracellular near it wall, fibrosis or variations in anatomy of biliary apparatus.^[4] Hence, preoperative USG scan can help in predicting successful outcome of laparoscopic removal of gallbladder.

The main aim of this study was to assess preoperative USG imaging of pericholecystic adhesions. A secondary aim was to assess its reliability in predicting chances of complications during laparoscopic cholecystectomy and hence a final management by open surgery

Aims & Objectives

- To compare the accuracy of USG in predicting pericholecystic adhesions in patients with GSD

Objectives

- To evaluate role of USG in detecting pericholecystic adhesions in patients with GSD
- To evaluate the accuracy of USG in predicting adhesions using operative findings as gold standard

MATERIALS & METHODS

Patients with suspected gall bladder disease referred to our department for imaging evaluation and who met the inclusion criteria were included in the study. Seventy patients were enrolled in our study. Of 70 patients enrolled in our study, only 55 were finally included in the study, as final surgical data was not available for 15 patients.

Inclusion Criteria

- All patients with cholelithiasis on USG were included in the study.

Exclusion Criteria

- Patients who had undergone partial cholecystectomy in the past
- Debilitated patients were excluded from the study
- Children <15 and patients unable to understand and give informed consent were excluded from the study

Risks from the study

No particular risk was involved in the imaging over and above the risks of the operative procedure (cholecystectomy).

Definitions of Criteria Used Pericholecystic adhesions

Non-visualization of interfaces between GB wall and hepatic parenchyma; visualization of pericholecystic adhesions and presence of pericholecystic exudates / collection.

Non-visualization of Calot's Triangle

Cystic Duct and/ or Hepatic artery could not be identified separately, complete obscuration of Calot's triangle area and unclear anatomy of Calot's triangle.

Analysis- The collected data was recorded in excel sheets and analyzed using Stata (Stata Inc) and Excel (Microsoft 2010). Correlation was done between ultrasonographic & laparoscopic findings.

Patients were examined by USG scanner (Siemens, Acuson S2000). On USG, we analyzed following parameters pericholecystic adhesions and anatomy of Calot's triangle. Findings from USG were correlated with that of LC or OC. Final management of patient was recorded. Data was evaluated to assess if final management was affected by the pericholecystic anatomy.

Ultrasonography technique and patient preparation

The patients were kept in fasting state for at least 8 hours, before USG examination. Only water was allowed during fasting state. Patient was examined in supine and left lateral decubitus posture. Coupling agent was liberally applied to region of interest. For patients with average habitus, a 3.5 MHz transducer and for thin patients 5 MHz transducer was used. Images were obtained in both longitudinal and transverse planes.

RESULTS

Out of total 70 patients enrolled in our study, 15 patients did not undergo surgical intervention. Hence, our finally study included 55 patients with cholelithiasis for whom complete data could be collected. 14 patients (25.4%) underwent an open cholecystectomy, while the rest 41 (74.6%) patients

were managed uneventfully by laparoscopic cholecystectomy.

Demography: The included patients were predominantly female (n=40, 80%) with fewer (n=11, 20%) male patients. The mean age of the patients was 42.9+/-14.7 y. males included in study were older than females. The age distribution peak occurred at 40-50 years for female patients. Male patients tended to have a later peak at 50-60 years which led to this age subgroup being the second largest subgroup.

Table 1: Distribution of age groups by gender.

Age Group	Female	Male	Total
<20 years	1	1	2
20-30 y	10	1	11
30-40 y	11	1	12
40-50 y	12	2	14
50-60 y	8	5	13
60-70 y	2	0	2
70-80 y	0	1	1
Total	44	11	55

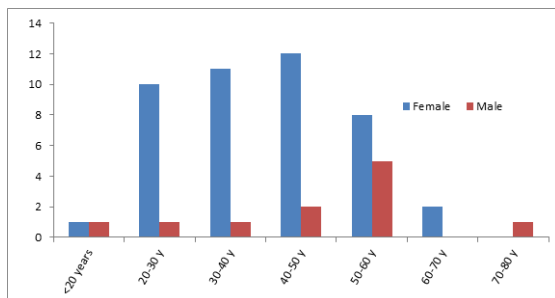


Figure 1: Bar diagram showing gender wise distribution of age groups.

Table 2: Summary of Demographic Details.

Demographic Details	
Total Patients (N)	55
Mean Age	42.9+/-14.7
Modal Age	45.0
Gender-Male	11(20%)
Gender-Female	44(80%)
Laparoscopic Cholecystectomy	41 (74.5%)
Open Cholecystectomy	14 (25.4%)

Incidence of pericholecystic abnormalities

Adhesions

Formation of pericholecystic adhesions is important sequelae of chronic cholecystitis. Presence of dense adhesions in pericholecystic region makes laparoscopic manipulation difficult. Therefore, it is important to be able to reliably predict presence of adhesions before initiation of surgery. In our subgroup of patients, adhesions were seen on ultrasonography in 43.6% (n=24) of cases. In contrast, assessment during operative procedure found that adhesions were present in 49.1% (n=27) of cases.

Visualization of Calot's Triangle

Clear visualization of Calot's triangle during operation is helpful for successful ligation of cystic duct and leading to an uneventful LC. Non-visualization of Calot's triangle anatomy is indirectly correlated with pathology in the region such as adhesions near the cystic duct, common bile duct or the cystic artery. All the above would be liable to complicate LC. Therefore, clear visualization of anatomy of Calot's triangle on imaging is considered an indicator of success of laparoscopy. In our study, optimal visualization on USG was possible only in 47.3% of all cases. USG non-visualization could predict 86% of cases which had to be converted to OC.

Table 3: Management of patient based on visualization of Calot's triangle on USG.

Visualization of Calot's Triangle on USG	Seen	Not Seen	Total
Laparoscopic Cholecystectomy	58.54%	41.46%	100.00%
Open Cholecystectomy	14.29%	85.71%	100.00%
Grand Total	47.27%	52.73%	100.00%

USG and Operative Correlation

USG correlation with operative evaluation was good in detection of adhesions. In 76.4% of cases, the finding of presence or absence of adhesions correlated with operation. Since operative evaluation is considered the gold standard to detect adhesions, this corresponds to a 76.4% accuracy of ultrasonography in detection of adhesions. In our study, we were able to detect pericholecystic adhesions with USG in 70.4% of cases and rule out adhesions in 82.1% of cases.

Table 4: Accuracy of ultrasonography in detecting pericholecystic adhesions.

Ultrasonography evaluation	Adhesions Present	Adhesions absent	Total
Adhesions Present	19 70.37%	5 17.86%	24 43.64%
Adhesions absent	8 29.63%	23 82.14%	31 56.36%
Grand Total	27 100.00%	28 100.00%	55 100.00%

Ultrasonography was found to be 70.4% sensitive, 82.1% specific and 76.4% accurate in preoperative prediction of adhesions.

Table 5: Test predictors for USG in detection of pericholecystic pathology Conversion to open surgery.

USG	Adhesions
Sensitivity	70.4
Specificity	82.1
Positive Predictive Value	79.2
Negative Predictive Value	74.2
Accuracy	76.4

Fourteen (25.4%) patients out of total 55 were managed by OC while 41 were managed via LC. The most important cause for management by open surgery was non-visualization of Calot's triangle

secondary to adhesions. 52.3% of cases in which Calot's triangle was not visualized were managed by open surgery. However, since the prevalence of adhesions was high in our subset of patients (49%, 27 of 55), presence of dense pericholecystic adhesions was leading cause for management by OC. Patients with fine or minimal adhesions were predominantly managed via LC while those who converted to OC predominantly had moderate to complete adhesions.

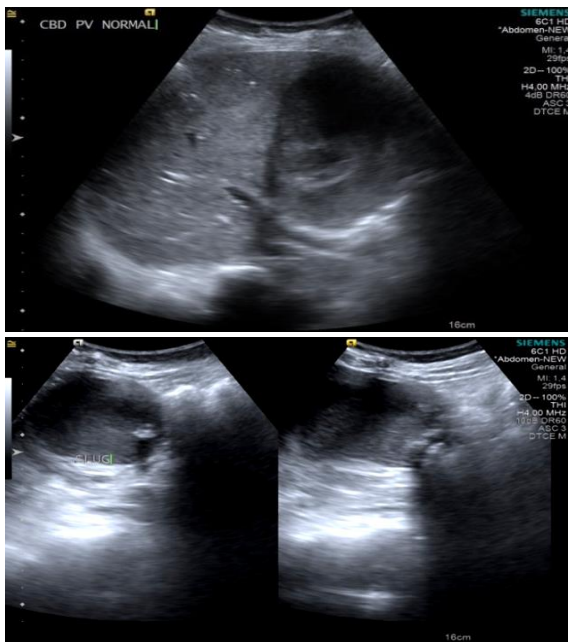


Figure 2a & b: USG images of GB in show necrosed GB, sludge and cholelithiasis.



Figure 3a & b: USG images show thickened GB walls with pericholecystic fluid, adhesions and cholelithiasis.



Figure 4: USG image shows non-visualisation of GB neck.



Figure 5: Presence of Adhesions on gall bladder during LC.

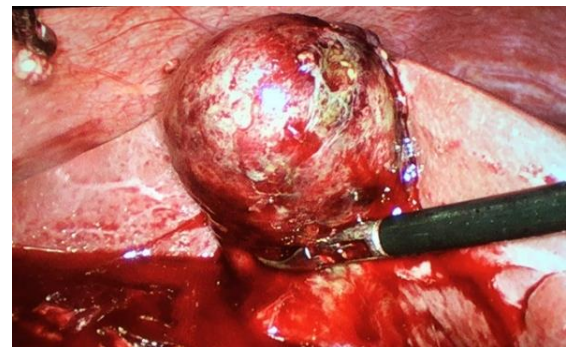


Figure 6: Presence of adhesions on GB leading to difficulty LC.



Figure 7: Postoperative dense adhesions leading to non-visualization of Calot's triangle.

DISCUSSION

Catalano OA et al.^[5] (2008) collected data on preoperative imaging findings that help predict a successful laparoscopic cholecystectomy. They found that patients with USG findings like thickened GB wall and presence of pericholecystic fluid were not adequately managed by LC.

Shapiro AJ et al.^[6] (1999) identified preoperative factors in patients with acute cholecystitis that would predict the need for conversion to open cholecystectomy. Most common reason for aborting the laparoscopic attempt was adhesions followed by suboptimal visualization of the triangle of Calot's.

Kumar Set al.^[7] (2007) reviewed 536 patients who underwent LC. They found that thickness of GB wall >4 mm was found to be a good predictor of operative difficulty during LC. The most frequent

reasons for intraoperative conversion to open surgery were non-visualization of Calot's triangle, adhesions in pericholecystic region and a collapsed GB.

Duncan CB et al (2012) reviewed the evidence-based management of complicated gallstone disease.^[8] Their review emphasized that ultrasound is the investigation of choice for evaluation of these cases.

Le VH et al (2012) conducted a similar study to identify causes of difficulty during LC leading to management by OC.^[9] They found that the most common reasons for difficulty were inflammatory pathology, adhesions in pericholecystic region and non-visualization of anatomy in that order.

Rizvi SAA et al. (2012) evaluated preoperative USG data predicting or forecasting a difficult cholecystectomy so as to provide benefits in term of better management of patients.^[10] The study concluded that radiological evaluation to determine the risk to laparoscopy has paramount importance and implications for surgical care.

Aslam HMet al. (2013) described the relative importance of clinical,^[11] biochemical and ultrasonographic parameters in preoperative assessment for GB surgery.

Cwik G et al. (2013) found that many USG factors were more common in OC group vs LC group.^[12] Out of these, presence of exudates around GB, suboptimal visualization of the pericholecystic anatomy on and GB wall thickening of >5 mm were significant predictors of OC.

Pinto Aet al (2013) & Melamud Ket al (2014) studied significant predictors of OC.^[13,14] They concluded that most important reason for OC was inability to visualize anatomy adequately.

Gupta G et al. (2015),^[15] Tosun A et al (2015) & Gaurav Gupta et al (2015) evaluated role of various factors responsible for conversion from laparoscopic to open cholecystectomy and also studied the intraoperative problems faced by the surgeon responsible for conversion in order to make the procedure safer for the patient as well as the surgeon.^[16,17] Significant predictors of conversion were obscured anatomy of Calot's due to adhesions, sessile gall bladder, male gender and gall bladder wall thickness >3 mm.

In our study 25.4% of the patients were managed by OC. This corresponded to studies by Indian authors Nidoni et al (24.4%) & Chand et al (24.4%) respectively.^[18,19] In contrast, study done by Sharma et al found that management of patients by OC was done in up to 45% of patients.^[20] Bingener et al reported managing 5.2% of the patients by open surgery.^[21] Ishizaki et al and Gence et al reported managing 7.5% & 3.16% of patients by open surgery respectively.^[22, 23]

The leading cause for management of patients by open surgery was presence of adhesions in our study. This was followed by non-visualization of Calot's

triangle. This finding corresponds with previous studies done by Genc et al, Sharma et al, Dianjiang et al and Gupta et al. In all the said studies, presence of adhesions formed the most important reason for conversion to open surgery. In contrast, studies done by Bingener et al, Nachnani et al, Gupta et al, Chand et al, Pavlidis et al found that non-visualization of the Calot's triangle was most important reason for management of patients by open surgery.^[15, 24-26]

Prediction using parameter

In our subgroup of patients, presence of adhesions combined with non-visualization of Calot's anatomy was numerically the leading cause for management by open surgery. 13/14 patients managed by open surgery had pericholecystic adhesions. Out of these, Calot's triangle was not visualized in 11 patients. This combined finding predicted management by open surgery in 78.6% of the cases (11/ 14). In 2 of the remaining 3 cases, adhesions were too dense to manage patients via LC. The last patient "was converted to open surgery due to excessive bleeding during surgery" had a long cystic duct on USG. In summary, USG was able to predict 92.8% (13/14) of the cases that had to be managed by OC by grading the severity of adhesions and combining several parameters such as non-visualization of Calot's triangle. Similar numbers have been reported by Nidoni et al (96%) & Gupta et al (90%) respectively.^[19] Garg et al used the presence of adhesions as a sole criterion and were able to predict 71% of cases that were to be managed by open surgery.^[27]

Analysis

- ❖ In our study, out of 55 patients, 44 were females suggesting that GSD is commoner in females.
- ❖ Our study shows that usual age of gall bladder stone disease is between 20-60 years, with maximum prevalence between 40-50 years.
- ❖ Our study shows that majority of patients with GSD can be managed by LC and only one-quarter may require OC.
- ❖ Our study shows that USG is excellent in predicting pericholecystic adhesions in GSD.
- ❖ USG is fairly good for visualization of Calot's triangle which is an important predictor for deciding appropriate management.

Our study shows that USG is 70-80% accurate in predicting difficult LC in GSD patients.

CONCLUSION

Using few important criteria like pericholecystic adhesions & non-visualization of Calot's triangle,

USG can be used as quick, non-invasive, inexpensive and readily-available imaging modality for predicting difficult laparoscopic cholecystectomy in patients with gall bladder stones diseases with fair degree of accuracy.

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