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# ROLE OF ULTRASOUND IN PREDICTING OPERABILITY IN LAPAROSCOPIC CHOLECYSTECTOMY: A PROSPECTIVE ANALYSIS.

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**Abstract**

**Background** : Now a days laparoscopic cholecystectomy is considered gold standard for symptomatic gall stone disease. Aim of our study was to identify predictors of difficult laparoscopic cholecystectomy based on different parameters on pre-operative ultrasound.

**Methods**: This is a retrospective study conducted in department of general surgery, VIMS Gajraula, Uttar Pradesh from May 2022 to April 2023. A pre-operative ultrasound was performed on the morning of surgery for all patient undergoing laparoscopic cholecystectomy which was corelated with various intra-operative parameters.

**Results**: A total of 110 patients were included in study. Most of the patients were of the age group between 40-50 years with average age of 43 years and 77 of the patients were females and 33 were male. Out of 110 patients, In 96 Patients laparoscopic cholecystectomy could be completed and remaining 14 required conversion to open surgery. According to ultrasound 25 cases were expected to be difficult. 14 patients required conversion to open surgery.

**Conclusion**: Pre-operative ultrasound with assessment of wall thickness and other various parameters is a good predictor for anticipation of difficult cholecystectomy and helps in surgical planning for open conversion if any required.

**Keywords:** Laparoscopic cholecystectomy, Ultrasound gall bladder, pericholecystic fluid, cholelithiasis, Contracted gall bladder.

## Introduction :

Mouret was first to introduce laparoscopic cholecystectomy (LC) in 1987[1]. Which established a radical change in the treatment of patients with gallstone disease. Laparoscopic cholecystectomy is considered gold standard and has many advantages which include reduced hospital stay, shorter recovery period, early mobilization and cosmetically better scar, less wound complication because of small incisions and less post operative pain[2-5]. At times laparoscopic cholecystectomy becomes difficult and may need conversion to open cholecystectomy even in experienced hands[6].

Ultrasonography (USG) is the routinely performed screening test for gall stone disease. It is non-invasive, safe, accurate screening test and gives reliable information related to gall stone disease. It can help surgeons to get an idea of anticipated difficulty to be faced during laparoscopic cholecystectomy in that particular patient[2]. On the basis of ultrasound findings, surgeons can select the cases aiming at reducing operative time and complications.
Ultrasonographic findings in preoperative period can very well predict the chances of conversion to the open procedure so that the surgeon and the patient are mentally prepared and an informed consent can be obtained[7].
This study was aimed to look for the predictive factors on ultrasonography of gallbladder pre-operatively that can give the surgeon a reasonable idea about the technical difficulty and complications that may be happen during the procedure of laparoscopic cholecystectomy.

**Materials and method**
The present study has been done on 110 patients with symptomatic gall bladder disease requiring cholecystectomy. The study has been conducted in Venkateshwara institute of medical science, Gajraula, Uttar Pradesh from May 2022 to April 2023. The criteria for selection of patients were as follows.

**Inclusion criteria**
All patients with symptomatic gall bladder disease who were declared fit for general anaesthesia after anaesthetic work up were included in the study.

**Exclusion criteria**
- All patients who were not fit for general anaesthesia or laparoscopy contraindicated due to cardiac cause or lung pathology.
- Patients with two or more previous upper abdomen open surgery.
- Patients with deranged liver function test (LFT), Jaundice, Cholangitis, common bile duct (CBD) stones, Pancreatitis, Portal Hypertension, Peritonitis, Empyema of gall bladder, Morbid obesity.
- Suspected cases of carcinoma gall bladder and biliary enteric fistula.
- Pregnant females.

All patients posted for laparoscopic cholecystectomy underwent routine blood investigation which included complete blood count, random blood sugar, kidney function test, liver function test with serum amylase and lipase, coagulation profile with viral markers. Chest x ray was done as routine. Few patients were subjected to electrocardiogram (ECG) and echocardiogram (ECHO) as per anaesthetic advice.
All patients undergoing laparoscopic cholecystectomy were subjected to pre-operative ultrasound on the morning of surgery after overnight fasting to assess the following criteria which may anticipate a difficult laparoscopic cholecystectomy (In our study, Presence of any one of the following 5 criteria was considered to be a predictor of difficult cholecystectomy)
1. GB thickness more than 3 mm
2. Peri-cholecystic oedema
3. Stone impacted at GB neck
4. Contracted gall bladder
5. CBD diameter > 6 mm

Presence of any of the following intra-operative observation during laparoscopic cholecystectomy was taken as difficult laparoscopic cholecystectomy.
1. Conversion to open due to various reason related to calots dissection, abnormal anatomy, bleeding due to dense adhesions.
2. Spillage of bile or stone due to tear of gall bladder (GB).
3. Time for Calot's dissection more than 20 min.
4. Dissection of gall bladder from liver bed more than 20 min.

5. Total duration of surgery from entry into abdomen to extraction of GB more than 90 min.

*Results*

A total of 110 patients who underwent cholecystectomy were studied under this study. Out of 110 patients, 77 were females and 33 were males. The age of the patients ranged from 11 to 80 years. The mean age was 43 years and most of the patients were between 40 to 50 years of age. Out of 110 patients on ultrasound, 25 patients had USG findings predicting a difficult cholecystectomy and remaining 85 were considered easy based on the USG findings. Out of 25 patients predicted as difficult on USG, 22 were really difficult intraoperatively and 3 turned out to be easy. Out of 85 patients predicted as easy based on USG finding, 19 patients turned out to be difficult and 66 were easy intra-operatively. Out of total 41 difficult cases intra-operatively, 14 required conversion to open surgery. In our study Conversion percentage to open was 34.1%.

Mean gall bladder wall thickness in our study was 2.7 mm. maximum wall thickness was 8 mm and minimum 1.7 mm. 9 patients had gallbladder wall thickness more than 3 mm on USG, and out of 9 we found 8 cases to be difficult and 1 easy. 101 patients had wall thickness less than 3 mm on ultrasound. Out of 101 cases 96 were easy and 5 turned out to be difficult. So GB wall thickness parameter on USG showed accuracy of 94.5%, sensitivity of 61.5%, positive predictive value of 88.8% and specificity of 98.8%.

8 patients had pericholecystic edema on USG, and out of 8 we found 7 cases to be difficult and 1 easy. 102 patients did not show peri-cholecystic edema on ultrasound. Out of 102 cases 100 were easy and 2 turned out to be difficult. So pericholecystic edema parameter on USG showed accuracy of 97.2%, sensitivity of 77.7%, positive predictive value of 87.5% and specificity of 99%.

7 patients had stone impacted at gallbladder neck on USG, and out of 7 we found all 7 cases to be difficult. 103 patients had mobile stones on ultrasound. Out of 103 cases 84 were easy and 19 turned out to be difficult. So impacted stone at GB neck parameter on USG showed accuracy of 82.7%, sensitivity of 26.9%, positive predictive value of 100% and specificity of 100%.

11 patients had contracted gallbladder on USG, and out of 11 we found 10 cases to be difficult and 1 easy. 99 patients did not show contracted gall bladder on ultrasound. Out of 99 cases 84 were easy and 15 turned out to be difficult. So contracted GB parameter on USG showed accuracy of 85.4%, sensitivity of 40%, positive predictive value of 90.9% and specificity of 98.82%.

3 patients had CBD diameter more than 6mm. less number was probably because we did not include cases of choledocholithiasis in our study. out of 3 we found 1 case to be difficult and 2 easy. 107 patients showed CBD diameter less than 6 mm. Out of 107 cases 97 were easy and 10 turned out to be difficult. So CBD diameter parameter on USG showed accuracy of 89%, sensitivity of 9.09%, positive predictive value of 33.3% and specificity of 97.9%. Table 1 summarises the statistical data of all 5 individual USG parameters with their Intraoperative outcomes.

**Table 1:** Comparison of individual USG parameters with intraoperative outcome.

| USG FINDING | No. of Cases | Intraoperative | | Accuracy | Sensitivity | Specificity | PPV |
|---|---|---|---|---|---|---|---|
| | | Difficult | Easy | | | | |
| GBWT >3mm | 9 | 8 | 1 | | | | |
| GBWT <3mm | 101 | 5 | 96 | 94.50% | 61.50% | 98.80% | 88.80% |
| Presence of pericholecystic fluid | 8 | 7 | 1 | | | | |
| No Pericholecystic fluid | 102 | 2 | 100 | 97.20% | 77.70% | 99% | 87.50% |
| Stone impacted at neck of GB | 7 | 7 | 0 | | | | |
| Freely mobile GB stone | 103 | 19 | 84 | 82.70% | 26.90% | 100% | 100% |
| Contracted GB | 11 | 10 | 1 | | | | |
| Normally distended GB | 99 | 15 | 84 | 85.40% | 40% | 98.82% | 90.90% |
| CBD diameter >6mm | 3 | 1 | 2 | | | | |
| CBD diameter <6mm | 107 | 10 | 97 | 89% | 9.09% | 97.90% | 33.30% |

**Discussion:**

Within the last three decades since the introduction of Laparoscopic cholecystectomy, it has become widely acceptable and now it is the procedure of choice for symptomatic gall bladder diseases.

Laparoscopic cholecystectomy is considered the gold standard for the treatment of symptomatic gall bladder diseases.

Because of heavy load of gall bladder cases in Northern India, Surgeons have become experienced and have started taking up more difficult cases as a routine. Laparoscopic cholecystectomy can be performed as daycare procedure in well Equipped settings.

Prediction of difficult cholecystectomy or risk of conversion to open is an important factor in planning for surgery as it may increase the cost and hospital stay and may put financial burden on the patient in developing nation like ours. So, in difficult cholecystectomy, patient needs to be informed about the possible complications which my arise during the procedure and a written consent must be obtained for this[8,9].

Many studies are published with a different scoring system to predict difficulty during laparoscopic cholecystectomy, but most of them are complex and use multifactorial data. They may be difficult to be used in daily practice and most of them cannot be applied preoperatively.

Laparoscopy may be difficult at times in patients having frozen Calot's due to dense adhesion, distorted anatomy due to dense omental adhesions, empyema of GB, contracted GB, previous upper abdominal surgeries, acute cholecystitis, impacted stones at GB neck and Mirizzi syndrome. In our experience we believe thick-walled GB pose difficulty in holding the infundibulum of GB during dissection. The conversion rate of gall bladder surgery ranges from 1.5 to 35%[8-11].

In our study, five parameters were analyzed in 110 patients for predicting difficult cholecystectomy. 25 numbers of cases were predicted as difficult on ultrasound, 22 out of 25 were difficult during surgery. 85 cases were predicted as easy, out of 85 easy cases 19 turned out to be difficult and 66 were easy intra-operatively giving a positive predictive value of 88% for difficult laparoscopic cholecystectomy, which is in accordance with previous studies [12]. Table 2 summarizes the statistical data corelating USG and Intraoperative findings of all 5 parameters together.

**Table 2:** USG parameters with intraoperative outcome.

| USG Finding including all 5 parameters. | | Intraoperative | |
|---|---|---|---|
| | | Difficult | Easy |
| No. of cases predicted to be difficult on USG | 25 | 22 | 3 |
| No. of cases predicted to be easy on USG | 85 | 19 | 66 |
| Accuracy | 80% | | |
| Sensitivity | 53.60% | | |
| Specificity | 95.60% | | |
| PPV | 88% | | |

Conversion rate to open cholecystectomy in our study was 34.1%. 14 of total 41 difficult cases were converted to open. A strong correlation was seen in our study between pre-op ultrasound and difficult laparoscopic cholecystectomy. Yetkin et al studied that 19 patients out of 108 patients needed conversion which was about 17.33% needed conversion to open[13].

Gall bladder wall thickness has been most extensively studied for gall stone disease. In the present study we have anticipated wall thickness more than 3 mm as difficult cholecystectomy.

In healthy individuals, 97 % of individual have gall bladder wall thickness < 2 mm. On ultrasonography GB wall thickness signifies sign of inflammation or fibrosis as a result of repeated attacks of cholecystitis. Jantsch et al found that in acute cholecystitis GB wall thickness is most often >4mm[14].

Fried et al and Corr et al found in their study that thickened GB wall 3 mm or > 3mm makes dissection of gall bladder difficult and is a risk factor in laparoscopy for conversion to open[3,15].

In our study we found 9 patients had gallbladder wall thickness more than 3 mm on USG, and out of 9 we found 8 cases to be difficult and 1 easy. 101 patients had wall thickness less than 3 mm on ultrasound. Out of 101 cases 96 were easy and 5 turned out to be difficult. So GB wall thickness

parameter on USG showed accuracy of 94.5%, sensitivity of 61.5%, positive predictive value of 88.8% and specificity of 98.8%. which is in closely comparable with previous study[16,17].
Dinkel et al in published a paper in which they found that sensitivity, specificity, positive predictive value and accuracy of GB wall thickening as an indicator of technical difficulty during lap chole were 66.7, 94.1, 84.2, and 85.3 percent respectively[16].
Lal et.al published a paper mentioning positive predictive value of ultrasound for predicting difficult lap. Chole was 80.95 percent and positive predictive for predicting conversion to open cholecystectomy was 61.90%[16].
In our present study ultrasonography has shown to be a reliable and predictable diagnostic tool for symptomatic gall bladder disease. Our study revealed a good correlation between GB wall thickness and difficult cholecystectomy. In our study we did not encounter any major injury like injury to portal vein, adjacent colon, duodenum or stomach.
Singh and Ohri in their study found 1518 patients as difficult out of 6147 patients which was about 21.5%[18].
The presence of fluid in GB bed was significantly associated with difficult cholecystectomy[19]. 8 patients had pericholecystic oedema on USG, and out of 8 we found 7 cases to be difficult and 1 easy. 102 patients did not show peri-cholecystic oedema on ultrasound. Out of 102 cases 100 were easy and 2 turned out to be difficult. So pericholecystic oedema parameter on USG showed accuracy of 97.2%, sensitivity of 77.7%, positive predictive value of 87.5% and specificity of 99%. Over all we noted peri-cholecystic oedema to be more sensitive and specific than GB wall thickening.

Stone impacted at the GB neck is another parameter which had been studied in detail and shows a good predictive value. The major difficulty with impacted stone is that it hinders holding the GB neck during dissection. Once the stone gets impacted the gall bladder gets overdistended with mucus making it more difficult for holding and manipulation[20]. In our study we found 7 cases with impacted stone at the GB neck. All cases were found to be difficult on surgery. 103 patients had mobile stones on ultrasound. Out of 103 cases which did not show impacted stone 84 were easy and 19 turned out to be difficult. So impacted stone at GB neck parameter on USG showed accuracy of 82.7%, sensitivity of 26.9%, positive predictive value of 100% and specificity of 100%.

The contracted GB is another parameter on ultrasonography which has good predictive value for difficult cholecystectomy[2,3]. In our study 11 cases were identified as contracted gall bladder. 10 out of 11 cases of contracted GB turned out to be difficult. 99 patients did not show contracted gall bladder on ultrasound. Out of 99 cases 84 were easy and 15 turned out to be difficult. So contracted GB parameter on USG showed accuracy of 85.4%, sensitivity of 40%, positive predictive value of 90.9% and specificity of 98.82%.
In our study CBD size did not prove to have a good correlation with difficult cholecystectomy which is not in accordance to previous articles and research papers[2,3]. 3 patients had CBD diameter more than 6mm. less number was probably because we did not include cases of choledocholithiasis in our study. Out of 3, we found 1 case to be difficult and 2 were easy. 107 patients showed CBD diameter less than 6 mm. Out of 107 cases. 97 were easy and 10 turned out to be difficult. So, CBD diameter parameter on USG showed accuracy of 89%, sensitivity of 9.09%, positive predictive value of 33.3% and specificity of 97.9%.

**Conclusion**

This study very well identifies and correlates with the various literature that gall bladder wall thickness > 3mm, contracted gall bladder, impacted stone at Hartman's, pericholecystic oedema and CBD diameter more than 6 mm are associated with difficulty in performing laparoscopic cholecystectomy. Pre-operative ultrasonography should always be used as a screening procedure as it is a good predictor of difficult laparoscopic cholecystectomy in majority of the cases. Preoperative ultrasonography can also help in recognition of cases where an open cholecystectomy may be considered. This prediction helps to anticipate difficulty in pre-operative period and to organize an

experienced team to handle the difficult situation. This study with above parameters provides adequate information in pre-operative period regarding difficulty and related complications so that a proper counselling of patient and attendants can also be done and an informed consent can be obtained mentioning related complications with chances of conversion.

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**Conflict of interest**: None declared

**Ethical approval**: The study was approved by the Institutional Ethical Committee.

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