International Journal of Surgery and Surgical Research
www.surgeryjournals.net
Online ISSN: 2664-9179, Print ISSN: 2664-9160
Received: 28-11-2023, Accepted: 13-12-2023, Published: 29-12-2023
Volume 5, Issue 1, 2023, Page No. 24-29

Prediction of difficult laparoscopic cholecystectomy based on Ultrasonographic Findings

Ali Basim Ali Al-Allawee[1], Mohammed Abbas Ali [2], Ali Abdulrasool Abbood[2]
[1] Department of Surgery, Al Imam Al-Husain, Medical City, Karbala, Iraq
[2] Department of Surgery, Karbala Health Institute, Surgery, Karbala, Iraq

Abstract
Background: Gallstone disease is one of the most common diseases of the gastrointestinal system; laparoscopic cholecystectomy is the gold standard operation for the definitive treatment of gallstones. Ultrasonography is the imaging technique of choice in detection of gallstones and is effective for follow-up of cholecystitis course. The operation can range from easy not complicated with obvious Calot's triangle to difficult surgery with obscure anatomy and may require conversion to open.
Aim of study: Utilization of pre-operative Ultrasonographic results in patients with chronic calculus cholecystitis to anticipate difficulties during laparoscopic cholecystectomy and to correlate preoperative Ultrasonographic findings with intra-operative findings during cholecystectomy.
Patients and method: It is an analytic cross-sectional study with 102 patients were operated on, the age group of the patients ranged from 15 to 70 years. The most prevalent sample was female (74%), 4 Ultrasonographic parameters were taken pre operatively including Gallbladder size, Gallbladder wall thickness, Gallstone mobility, Common bile duct diameter, and intraoperative parameters (total operation time, Calot's triangle dissection time, stripping of gallbladder time, any difficulty in extraction or spillage, and if it required conversion to open surgery.
Results: In the current study the result showed 66.7% of patients had ultrasound findings that predicts easy surgery and 33.3% had an ultrasound report that predicts difficult surgery, 31 patients of the before mentioned 33.3% had difficult surgeries while only 3 patients didn't, 2 statistically significant association (p=0.001). the positive predictive value was 91.5% while sensitivity was only 65% and specificity 97% for gallbladder wall thickness, while for contracted gallbladder the positive predictive value was 95% and (p=0.002), The positive predictive values for stone impaction and Common bile duct dilatation were (96%, 100%) respectively.
Conclusion: Preoperative ultrasonography results can be utilized as a screening tool to predict difficulties during laparoscopic cholecystectomy. In many times they are a good predictor of difficulty in the majority of cases. The surgeon may benefit from having a better understanding of the challenges he can encounter with a certain patient.

Keywords: Gallstones, laparoscopic cholecystectomy, Ultrasonography

Introduction

The gallbladder is an auxiliary organ of the digestive system that is located beneath the liver in the primary liver fissure, where the right and left lobes of the liver meet. It is a pear-shaped sac that is divided into four anatomical regions: the fundus, body, infundibulum, and neck [1]. The fundus is the rounded and non-perforated terminal part that typically protrudes 1 to 2 cm beyond the edge of the liver and houses the majority of the organ's smooth muscle. The body serves as the primary reservoir and houses the majority of the elastic tissue, enabling it to stretch and expand. The gallbladder narrows towards its neck, where there is a protrusion of the mucosa called the infundibulum or Hartmann's pouch, located at the intersection of the neck and the cystic duct. Furthermore, the neck of the gallbladder is situated in the most profound section of the gallbladder fossa and may protrude slightly into the unattached segment of the hepatoduodenal ligament, where it joins with the cystic duct [2].

In adults, the gallbladder measures approximately 7 to 10 cm in length and 3 to 4 cm in width. The gallbladder has a capacity of around 30-50 ml. However, in cases of obstruction, it can significantly expand and hold up to 300 mL of fluid [2]. The gallbladder wall can have a maximum thickness of 2 mm, which can change dependsing on its distension and inflammation. The gallbladder is closely connected to the liver by a network of loose connective tissue that includes tiny veins and lymphatics linking the gallbladder and the liver. The portion of the gallbladder that is not in direct touch with the liver is enveloped by the peritoneum, which is reflected from the liver. The gallbladder is anatomically linked to the cystic duct, which subsequently empties into the common hepatic duct. The cystic duct measures approximately 3 to 4 centimetres in length and connects the common hepatic duct with the common bile duct [3]. The common bile duct passes through the head of the pancreas and terminates at the sphincter of Oddi. It then penetrates the wall of the duodenum and forms the ampulla of Vater, where it merges with the pancreatic duct. The main papilla, which is formed by the junctions of the choledochoduodenal and pancreaticoduodenal, is located in the second part of the duodenum. Both the cystic duct and the normal bile duct lack peristaltic movement. The gallbladder is supplied with arterial blood by the cystic artery, which often originates from the right hepatic artery. However, in some instances, it may also develop from the left hepatic, common hepatic, or gastroduodenal arteries [4]. The gallbladder collects venous blood through a network of tiny veins instead of a large cystic vein, which eventually empties into the portal vein. The lymphatic drainage from

the gallbladder follows two primary routes, one leading to the celiac nodes and the other to the superior retropandcreaticoduodenal node [5].

1. Physiology and Pathophysiology

The primary role of the gallbladder is to store and concentrate bile during periods of fasting. It then contracts and releases bile through the bile ducts into the small intestine via the ampulla of Vater in reaction to eating. Approximately 80-90% of gallstones generated in the gallbladder are mostly composed of cholesterol (70%) together with bile pigments, calcium salts, and glycoproteins [6]. In addition to pure and mixed cholesterol stones, pure pigment stones are also present. Biliary tract infections, caused by bacterial and helminthic deconjugation of bilirubin glucuronides, are commonly linked to the formation of brown pigment stones. These stones are particularly prevalent in Asia. Black pigment stones mostly comprise calcium bilirubinate and are commonly observed in individuals with hemolytic anaemia or inefficient hematopoiesis, as well as in patients diagnosed with cystic fibrosis [7]. The development of cholesterol gallbladder stones typically involves three primary mechanisms: (i) Excessive cholesterol concentration in bile; (ii) Reduced gallbladder movement; and (iii) Protein factors that promote the creation of stone nuclei [8]. Gallstone disease is a prevalent condition affecting the gastrointestinal system, with a prevalence of 7.9% in males and 16.6% in women, as reported by the third National Health and Nutrition Examination Survey. The majority of instances are asymptomatic, with approximately 1-2% of these patients experiencing symptoms annually [9].

2. Treatment

Laparoscopy has emerged as the preferred method for performing cholecystectomy since its inception over 30 years ago, and is now one of the most frequently conducted elective general surgical operations [10]. Laparoscopic cholecystectomy (LC) varies in the difficulty of the procedure; for example, it can be a routine operation smoothly performed by a trainee surgeon (under appropriate supervision), or at its most difficult, can be a troublesome procedure for even the most experienced specialist surgeon [11]. Several factors affect directly or indirectly in LC procedure making it more difficult than usual and may lead to partial cholecystectomy, cholecystestomy or conversion to Open Cholecystectomy (OC) [12], in other studies such as Kama *et al* [13]. few parameters were taken to identify the risk to convert to OC namely male gender, previous upper abdominal surgery, sonographically ascertained thick gallbladder wall, age more than 60 years and preoperative diagnosis of acute cholecystitis were found to have a significant effect on the risk of conversion, in this study we have taken the pre-op. sonographic parameters. Ultrasound (US) is the preferred imaging technique for cholelithiasis discovery and is better than other imaging modalities in the first examination of acute biliary illness and assists to triage patients that call for more imaging from those who do not [14], with sensitivity and specificity of more than 92% in diagnosing cholelithiasis [15]. In this study we took certain ultrasonographic parameters for gallbladder (GB) which are:-

1- Wall thickness. 2- Gallbladder size. 3- Gallstone(s) mobility. 4- Common bile duct diameter and were taken as an outpatient for elective LC, which may predict intraop.

Difficulty in form of total operational time, Calot's triangle dissection time, stripping the gallbladder from the bed and extraction with spillage of bile or stones, or conversion to OC.

AIM

Utilization of pre-operative ultrasonographic results in patients with chronic calculus cholecystitis to anticipate difficulties during laparoscopic cholecystectomy and to correlate preoperative ultrasonographic findings with intra-operative findings during cholecystectomy.

Patients and Method

This analytic cross-sectional study was carried out from March /2022 to October/2022 in general surgical theatres of Karbala Province Hospitals with cooperation of the outpatient clinic of ultrasonographers, 102 patients of both genders and an age group of 15 years and older who had one or more attacks of acute cholecystitis and were scheduled for elective LC, and underwent a detailed US study a few days earlier. Four US parameters were considered preoperatively in all patients:

1. Gallbladder size: Normal distention or contracted.
2. Gallbladder wall thickness.
3. Gallstone mobility inside the GB: mobile or impacted in the neck of the GB.
4. CBD diameter: less than 8 mm or more than 8mm.

The ultrasound reports were conducted by ultrasonographers using the same ultrasonic device settings. The patients were required to fast before the examination and lie supine, and then tilt to another position to observe the mobility of the stones. These ultrasound reports were used as preoperative indicators of challenging surgery if any of the following findings were positive:

1. Contracted GB
2. GB wall thickness is more than 2 mm
3. Gallstone is impacted in the neck of the GB
4. CBD diameter is more than 8 mm Intra-operative assessment during laparoscopic cholecystectomy
1. Total time of operation (less than 90 minutes or more than 90 minutes).
2. Time started from the insertion of 1st port to closure of the skin.
3. Time taken to dissect Calot’s triangle (less than 20 minutes or more than 20 minutes)
4. Time taken to strip GB from its fossa (less than 20 minutes or more than20 minutes)
5. Any difficulty in extraction of GB (if retrieval of the specimen required increasing the size of the port), with spillage of bile or stones.
6. Conversion to OC, if any.

If any of the following intraoperative assessment was found to be positive, the case was considered as difficult LC:

1. Total time of operation more than 90 minutes.
2. Time taken to dissect Calot’s triangle more than 20 minutes.
3. Time taken to strip GB from its fossa more than 20 minutes.

4. Difficulty in extraction of GB from the port site, or spillage of bile or stones
5. Conversion to OC.

Inclusion criteria

1. Both genders, age more than15 years old.
2. Patients had previous one or more attacks of acute cholecystitis.

Exclusion criteria

1. Evidence of concomitant Choledocholithiasis.
2. Patient who are unfit for General Anesthesia.
3. Patient who had previous upper abdominal surgery.
4. Patient who had abnormal LFTs.
5. Patient refusal.

Operation details

The laparoscopic cholecystectomies were performed by skilled surgeons. The patient was placed in a supine position under general anaesthesia. The procedure began by introducing the first port and injecting CO2 into the abdominal cavity. Then, three additional ports were inserted. The patient was then positioned in a reverse Trendelenberg's position and slightly tilted to the left. The dissection of Calot's triangle was initiated, starting with the infundibulum-cystic angle and continuing until a critical view of safety was achieved. After clipping and separating the gallbladder from its bed, it was extracted through the epigastric port.

Ethical considerations

Participation in the study was optional. The objectives of the study were explained to the patients by the researcher. Verbal consent was taken from all the patients who decided to participate in the study. Complete confidentiality was ensured. The participants were informed that all the collected data will be used for research purposes only, and personal information will be collected with serial identification numbers without an identity.

Statistical Analysis

Data were introduced into Microsoft excel sheet 2019 and loaded into SPSS (Statistical Package for Social Sciences) version (24). Categorical data are presented as numbers and percentages. An Independent t-test was used to measure the difference between groups' parametric variables. P-value less than 0.05 was considered as discrimination of significance.

Results

The total patient sample of the present study was 102 patients with mean age 41.5±10.3, the age group of the patients ranged from 18 to 70 years. The most prevalent sample was female 74%, while male formed 26%, As indicated in figure (1).

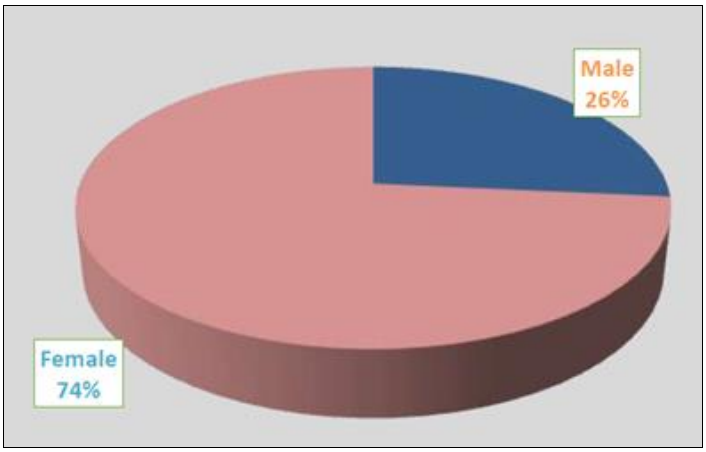

Fig 1: Displays the distribution of the entire patient sample based on gender.

In current study the result showed 66.7% of patients had US interpretations that predicted easy surgery and 33.3% had findings that predicted difficult surgery. As shown in figure (2).

Fig 2: Displays the distribution of the entire patient sample based on US interpretations.

As a result of the current study, we found 76.5% had normal gallbladder wall thickness and 23.5% were thickened. The GB was contracted in 18.6%. Regarding to stone mobility inside the gallbladder, the result showed only 24.5% were impacted stones and 2.9% of all participants had dilated CBD. As indicated in table (1).

Table 1: Displays the distribution of the complete patient sample based on US parameters.

Ultrasonographic parameters	No.	Percentage
Wall thickness		
• Normal	78	76.5
• Thickened	24	23.5
Size		
• Normal distention	83	81.4
• Contracted	19	18.6
Stone mobility		
• Mobile	77	75.5
• Impacted	25	24.5
CBD diameter		
• Normal	99	97.1
• Dilated	3	2.9
Total	102	100

Regarding intraoperative findings, the result showed 8.8% of patients had a total operative time more than 90 min, and 31.4% had Calot's triangle dissection time more than 20 min, while 19.6% had GB stripping from the bed time more than 20 min. in addition to that 33.3 % of patients had difficult extraction or spillage and 1% underwent conversion. As indicated in table (2).

Table 2: Presents the distribution of the complete patient sample based on intraoperative findings.

Intraoperative findings	No.	Percentage
Total time		
• Less than 90 min	93	91.2
• More than 90 min	9	8.8
Calot's triangle dissection time		
• Less than 20 min	70	68.6
• More than 20 min	32	31.4
GB stripping from the bed time		
• Less than 20 min	82	80.4
• More than 20 min	20	19.6
Extraction or spillage		
• Easy	68	66.7
• Difficult	34	33.3
Conversion		
• No	101	99
• Yes	1	1
Total	102	100

The findings of the present study revealed that out of the 31 patients who were projected to have difficult surgeries based on ultrasound (US) results, all of them indeed had difficult surgeries. Conversely, only 3 patients who were anticipated to have simple surgeries based on US results actually had difficult surgeries. This link between US predictions and surgical difficulty was statistically significant (p=0.001). The ultrasound demonstrated a sensitivity of 91% and a specificity of 95%. The positive predictive value of the ultrasound was 92%, and the accuracy of the test was 94%.

Table 3: Displays the association between the interpretations made in the United States and the level of difficulty in executing procedures.

US prediction	Operative difficulty		Total	P-value
	Difficult	Easy		
Difficult	31	3	34	0.001
Easy	3	65	68	
Total	34	68	102	

Predictive value of gallbladder wall thickness for difficult surgery, 22 out of 24 patients with increased gallbladder wall thickness had difficult surgery, with statistically significant association (p=0.001). Positive predictive value was 91.5% while sensitivity was only 65% and specificity 97%. Accuracy of gallbladder wall thickness was 86%. As indicated in table (4).

Table 4: Presents the correlation between the wall thickness of the gallbladder in the United States and the level of difficulty during surgery.

Wall thickness	Operative difficulty		Total	P-value
	Difficult	Easy		
Thickened	22	2	24	0.001
Normal	12	66	78	
Total	34	68	102	

Regarding to gallbladder size for prediction of difficult surgery, all patients except one with contracted gallbladder had difficult procedures, with statistically significant association (p=0.002). Positive predictive value was 95% while sensitivity, specificity and accuracy were (53%, 98% and 83% respectively). As indicated in table (5).

Table 5: Correlation between the size of GB in the US and operative difficulty.

Size	Operative difficulty		Total	P-value
	Difficult	Easy		
Contracted	18	1	19	0.002
Normal distention	16	67	83	
Total	34	68	102	

The result showed only one out of 25 patients with impacted stone underwent easy surgery, with a statistically significant association (p=0.001). The positive predictive value was 96%. While sensitivity was 70.6 while the specificity was 98.5% with the accuracy test being 89.2%. As shown in table (6).

Table 6: Correlation between stone mobility in GB in the US and operative difficulty.

Stone mobility	Operative difficulty		Total	P-value
	Difficult	Easy		
Impacted	24	1	25	0.001
Mobile	10	67	77	
Total	34	68	102	

Regarding CBD diameter in correlation to difficult surgery, all the 3 patients with dilated CBD underwent a difficult procedure, with a statistically significant association (p=0.013). Positive predictive value was 100% while sensitivity, specificity and accuracy were (9%, 100% and 69% respectively). As shown in table (7).

Table 7: Correlation between CBD diameter in the US and operative difficulty.

CBD diameter	Operative difficulty		Total	P-value
	Difficult	Easy		
Dilated	3	0	3	0.013
Normal	31	68	99	
Total	34	68	102	

Discussion

Gallstone disease is one of the most widespread gastrointestinal system illnesses; Pre-operative ultrasound is the main imaging technique for patients undergoing cholecystectomy. Ultrasound provides a sensitive approach for analyzing the characteristics of the gallbladder (9). Laparoscopic cholecystectomy is now the gold standard and first choice operation for symptomatic cholelithiasis in the last few decades [16], the operation ranges from being straightforward with minimum complications intra-op. to difficult procedure due to distorted anatomy following dense adhesions in the Calot's triangle, empyema of the gallbladder, contracted gallbladder, previous upper abdominal operations, and acute cholecystitis [16].

Several previous studies did a correlation between US and intra-op. LC difficulty and a few independent scoring systems were implied [11, 17, 18]. In our study, the highest proportion of patient aged 30-43 years agreed with the result of previous studies [17, 18]. The result showed the majority of patients who suffered from GS were females (74%), which is the same for most studies that deals with GS [17, 18]. Regarding the distribution of US parameters of this study sample, which is the most efficient imaging technique in pre-op. assessment of GB status [14]; We found that wall thickness, contracted GB and stone mobility were (23.5%, 18.6%, 24.5%) respectively, and CBD was dilated only in 3 patients (2.9%), approximately near the results of Chuahan, S. et. al study [19].

In the current study, there is a significant association between preop. US findings and surgical intervention difficulty (p-value=0.001), similar to Griffiths EA. *et al*. study [11], with most of the patient with US findings that predict to be difficult underwent difficult surgeries (91%), as near the result of Chand P. *et al*. study [17]. Regarding the US parameters we depended on in this study, GB wall thickness was significantly impacted on surgical procedure time and difficult extraction of the gallbladder with other intra-op. complications (p=0.001) with positive predictive value of 91.5%, while sensitivity was only 65% and specificity 97%. Consistent with the findings of Raman SR. *et al*., the p-value was same, and Chand *et al*. demonstrated nearly identical predictive value [17, 20]. In our study, we also considered GB size as a secondary parameter in the United States and categorised it into two groups: normal distention and contracted. A contracted GB occurs after a series of recurring inflammation episodes and subsequent adhesions in the area known as Calot's triangle. This condition can significantly impact the duration of the operation and make the dissection of Calot's triangle more challenging. There is also a risk of stones spilling into the intraperitoneal cavity. Our study revealed that almost all cases with contracted GB experienced difficult surgeries (P=0.002), and the positive predictive value was 95%. This finding aligns with a study conducted by Bansal A. *et al*., which yielded similar results [18]. The presence of a stone lodged in the neck of the gallbladder is a reliable indicator of the level of difficulty that may be encountered during laparoscopic cholecystectomy, as demonstrated by the results of the study. This correlation is statistically significant, with a p-value of 0.001. The positive predictive value was 96%, consistent with the findings of previous investigations [21, 22], while contradicting other studies [23].

In the studies conducted by Siddiqui *et al*. [24], Nassar AH. *et al*. [25], and in our own investigation, the diameter of the common bile duct (CBD) above 8 mm was identified as a significant predictor of difficulties (p=0.013). Nevertheless, Carmody *et al*. [26] concluded that preoperative ultrasonography examination has little usefulness in identifying challenging individuals during screening. The low rate of conversion can be attributed to our strict adherence to fundamental surgical techniques, such as the safe 1st port entrance technique, maintaining adequate vision, minimising the use of electrocautery at the triangle of Calot's, displaying the structures at the triangle of Calot's before clipping, applying adequate traction in the correct direction, and ensuring effective hemostasis.

Study limitation

This was a single-center study with a limited number of cases. A large multi-center study with additional patient parameters would yield more consistent results.

Conclusion

Preoperative ultrasonography results can be utilized as a diagnostic tool to predict difficulties during laparoscopic cholecystectomy. In many times they are a good predictor of difficulty in the majority of cases. The surgeon may benefit from having a better understanding of the challenges he can encounter with a certain patient.

Recommandations

We recommend that performing US in the early pre-operative period can result in fewer and more anticipated complications, and the possible need for help of a more experienced senior surgeon, and for thepatient's understanding of possible complication. Further studies with

correlation with other patient and imaging criteria are recommended.

References

1. Conlon KCP. The Gallbladder and Bile Ducts. In: Bailey & Love's Short Practice of Surgery. 27th ed. Boca Raton: CRC Press, Taylor & Francis Group, 2018, 1188–1211.
2. Haisley RK, Hunter GJ. Gallbladder and the Extrahepatic Biliary System. In: Schwartz. 11th ed. Distrito Federal: McGraw-Hill Interamericana, 2015, 1393–427.
3. Housset C, Chrétien Y, Debray D, Chignard N. Functions of the Gallbladder. Comprehensive Physiology, 2016, 1549–77.
4. Halvorsen JF, Myking AO. The Arterial Supply and Venous Drainage of the Gallbladder. A Study of One Hundred Autopsies. Acta Chirurgica Scandinavica,1971:137:659-664.
5. Sato T, Ito M, Sakamoto H. Pictorial Dissection Review of the Lymphatic Pathways from the Gallbladder to the Abdominal Para-aortic Lymph Nodes and Their Relationships to the Surrounding Structures. Surgical and Radiologic Anatomy,2013:35:615-621.
6. Paumgartner G, Sauerbruch T. Gallstones: Pathogenesis. Lancet,1991:338:1117-21.
7. Angelico M, Gandin C, Canuzzi P, *et al*. Gallstones in Cystic Fibrosis: A Critical Reappraisal. Hepatology,1991:14:768–75.
8. Marschall HU, Einarsson C. Gallstone Disease. Journal of Internal Medicine,2007:261(6):529-42.
9. Afdhal NH, Zakko SF. Gallstones: Epidemiology, Risk Factors and Prevention. UpToDate.com, updated, 2018, 27.
10. Pucher PH, Brunt LM, Davies N, Linsk A, Munshi A, Rodriguez HA, *et al*. Outcome Trends and Safety Measures After 30 Years of Laparoscopic Cholecystectomy: A Systematic Review and Pooled Data Analysis. Surgical Endoscopy,2018:32(5):2175-83.
11. Griffiths EA, Hodson J, Vohra RS, Marriott P, Katbeh T, Zino S, *et al*. Utilization of an Operative Difficulty Grading Scale for Laparoscopic Cholecystectomy. Surgical Endoscopy,2019:33(1):110-21.
12. Gupta N, Ranjan G, Arora MP, *et al*. Validation of a Scoring System to Predict Difficult Laparoscopic Cholecystectomy. International Journal of Surgery,2013:11(9):1002-1006.
13. Kama NA, Kologlu M, Doganay M, Reis E, Atli M, Dolapci M. A Risk Score for Conversion from Laparoscopic to Open Cholecystectomy. American Journal of Surgery,2001:181:520-525.
14. Alshargi AO, Al-sallami SE, Hejazi HA, Alahdal AI. Accuracy of Ultrasound in Diagnosis of Cholecystitis. The Egyptian Journal of Hospital Medicine,2018:73(7):7146-52.
15. Sharif S, Vlahaki D, Skitch S, Truong J, Freeman S, Sidalak D, Healey A. Evaluating the Diagnostic Accuracy of Point-of-Care Ultrasound for Cholelithiasis and Cholecystitis in a Canadian Emergency Department. Canadian Journal of Emergency Medicine,2021:23(5):626-30.
16. Chen RC, Liu MH, Tu HY, Chen WT, Wang CS, Chiang LC, *et al*. The Value of Ultrasound Measurement of Gallbladder Wall Thickness in Predicting Laparoscopic Operability Prior to Cholecystectomy. Clinical Radiology,1995:50(8):570-2.
17. Chand P, Singh R, Singh B, Singla RL, Yadav M. Preoperative Ultrasonography as a Predictor of Difficult Laparoscopic Cholecystectomy that Requires Conversion to Open Procedure. Nigerian Journal of Surgery,2015:21(2):102-5.
18. Bansal A, Mahobia HS, Waghoikar G. A Clinical Study to Determine Predictive Factors for Difficult Laparoscopic Cholecystectomy. International Journal of Surgery,2020:4(4):126-32.
19. Chauhan S, Masood S, Pandey A. Preoperative Predictors of Conversion in Elective Laparoscopic Cholecystectomy. Saudi Surgical Journal,2019:7(1):14.
20. Raman SR, Moradi D, Samaan BM, Chaudhry US, Nagpal K, Cosgrove JM, Farkas DT. The Degree of Gallbladder Wall Thickness and Its Impact on Outcomes After Laparoscopic Cholecystectomy. Surgical Endoscopy,2012:26(11):3174-9.
21. Gupta N, Ranjan G, Arora MP, Goswami B, Chaudhary P, Kapur A, *et al*. Validation of a scoring system to predict difficult laparoscopic cholecystectomy. Int J Surg,2013:11(9):1002-6.
22. Dhanke PS, Ugane SP. Factors predicting difficult laparoscopic cholecystectomy: a single-institution experience. Int J Students Res, 2014, 4(1).
23. Santambrogio R, Montorsi M, Bianchi P, *et al*. Technical difficulties and complications during laparoscopic cholecystectomy: predictive use of preoperative ultrasonography. World J Surg,1996:20(8):978-81.
24. Siddiqui M, Rizvi S, Sartaj S, Ahmad I, Rizvi S. A standardized ultrasound scoring system for preoperative prediction of difficult laparoscopic cholecystectomy. J Med Ultrasound,2017:25:227–231.
25. Nassar AH, Hodson J, Ng HJ, Vohra RS, Katbeh T, Zino S, *et al*. Predicting the difficult laparoscopic cholecystectomy: development and validation of a pre-operative risk score using an objective operative difficulty grading system. Surg Endosc,2020:34(10):4549-61.
26. Carmody E, Arenson A, Hanna S. Failed or difficult laparoscopic cholecystectomy: can preoperative ultrasonography identify potential problems. J Clin Ultrasound,1994:22(6):391–396.