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Technical Difficulties And Complications During Laparoscopic Cholecystectomy: Predictive Use Of Pre-Operative Ultrasonography

General Surgery

KEYWORDS: Easy laparoscopic cholecystectomy, difficult laparoscopic cholecystectomy, Preoperative ultrasonographic criteria.

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ABSTRACT

BACKGROUND : Cholelithiasis is the most common biliary pathology. Gallstones are present in 10% to 15% of general population .Approximately 1% to 2% of asymptomatic patients will develop symptoms requiring cholecystectomy every year, making it one of the most common operations performed.In about 5% to 10% cases of laparoscopic cholecystectomy, conversion to open cholecystectomy may be needed for safe removal of gallbladder. Therefore it is necessary to predict such difficult laparoscopic cholecystectomy with pre-operative ultrasonographic criteria.

AIMS : To evaluate the technical difficulties and complications during laparoscopic cholecystectomy and its prediction by pre-operative ultrasonography.

MATERIALS AND METHODS: A prospective longitudinal study was conducted from September 2014 to August 2016 that included 200 patients who underwent elective laparoscopic cholecystectomy for uncomplicated gallstone disease. The study was conducted at one surgical unit in Department of Surgery in collaboration with Department of Radio-diagnosis, Regional Institute of Medical Sciences. Descriptive statistical analysis was carried out using SPSS 21, IBM Corp, Chicago, Il. Descriptive statistics was presented as mean, median, standard deviation, frequency and percentage.

RESULTS : In this study out of 200 patients, 127(63.5%) patients have only gallstones and 73(36.5%) patients have ultrasound findings of gallstones associated with other findings in gallbladder. Out of these 73 patients, 11% patients have gallbladder wall thickness more than 4mm; 15.5% patients have gallbladder stone impacted at the neck; 6.5% patients have contracted gallbladder; 3.5% patients have common bile duct diameter more than 6mm. Gall bladder wall thickness more than 4mm leads to difficult laparoscopic cholecystectomy in 63.6% cases. 13 patients have contracted gallbladder and 61.5% of them had undergone difficult laparoscopic cholecystectomy. In the present study, 7 patients had common bile duct dilated more than 6mm and all of them had to undergo difficult laparoscopic cholecystectomy. Time taken from insertion of trocar to gallbladder extraction is more than 90mins in majority of cases (48% vs 11.8%) with ultrasound findings of gallstones associated with other findings than the cases with ultrasound findings of gallstones only. Intra operative complications which led to difficult laparoscopic cholecystectomy; majority of cases (56%) had dense adhesions at calots triangle and surrounding structure followed by tear of cystic artery during dissection which accounted for 24.4% of patients.

CONCLUSION : Ultrasonographic findings of gallbladder wall thickness more than 4mm, stone impacted at the neck of gallbladder, contracted gallbladder, common bile duct diameter more than 6mm are found to be significant predictors of difficult laparoscopic cholecystectomy in our study.

INTRODUCTION

Laparoscopic cholecystectomy is a revolutionary change in the treatment of patients with gallbladder stones. Mouret introduced laparoscopic cholecystectomy in1987.[1] This surgical event took place in Lyon, France and was not reported. In Paris, Francois Dubois eventfully performed his first laparoscopic cholecystectomy in april 1988.[2] Dr. Eddie Reddick reported 100 cases of laparoscopic cholecystectomy in 1989. The classical four port technique of laparoscopic cholecystectomy as described by Reddick became the most widely adopted technique. Laparoscopic cholecystectomy was considered by most to be at its zenith since its inception in the early 1990s and is also now done by 2 and 3 ports. When laparoscopic cholecystectomy was started, only simple gall stone disease was considered as indication. With increasing expertise and introduction of newer instruments, acute cholecystitis has also become one of the indications for laparoscopic cholecystectomy. Now any type of calculus cholecystitis can be managed by laparoscopic method. Since the first laparoscopic cholecystectomy, the procedure had gained a foothold and has now become the gold standard approach for gallstone diseases. It has been said that the development of laparoscopic cholecystectomy is the single most important event in general surgery in the last 30 years.[3]

Laparoscopic cholecystectomy has rapidly replaced open cholecystectomy as the standard treatment. Advantages of laparoscopic cholecystectomy include reduced hospitalization, decreased morbidity, short recovery time, and better cosmesis.[4] In addition, studies evaluating physiologic and biochemical responses show minimal change in the above parameters.[5]

However, compared with open cholecystectomy, the incidence of injuries to the bile duct seems to be increased.[6] Patients with long-standing disease and previous bouts of cholecystitis or pancreatitis are at higher risk of experiencing a difficult procedure or conversion and may be at increased risk of bile duct injury or injury to the adjoining viscera.[7] Certain conditions preclude laparoscopic cholecystectomy and may lead surgeons to perform conventional open cholecystectomy, including pericholecystic adhesions and adhesions between the common bile duct, the cystic duct, and the cystic artery(Calot's triangle), which are exposed during surgery. These conditions may significantly prolong laparoscopic preparation time and may cause bleeding or gallbladder rupture. Frequently, conversion to laparotomy occurs after a patient has complications during laparoscopic cholecystectomy such as rupture of the gallbladder, significant bleeding from the gallbladder bed, or inadvertent injury to a bile duct, which may occur after the incomplete surgical exposure of Calot's triangle.[8] Of all laparoscopic cholecystectomy, 1 to 13% requires conversion to an open if the anatomy of calot's triangle is not clear or an uncontrolled bleeding occurs.[9] Surgical time and cost increases considerably in patients who must undergo conventional cholecystectomy. Therefore, candidates for laparoscopic cholecystectomy should be identified before they go to the operating room. The term 'difficult cholecystectomy' refers to multiple technical intra-operative difficulties that increase the risk for complications and significantly prolong the operating time.[10] Although most patients will also benefit from the laparoscopic approach, difficult cases are at a higher risk for conversion and the resulting complications that may overshadow all advantages of the laparoscopic procedure, making this approach unsafe, uneconomic, inefficient, and hence possibly inferior to traditional open cholecystectomy.

There are several conditions that make laparoscopic cholecystectomy a technically difficult procedure. These include acute cholecystitis, empyema gall bladder, gangrenous cholecystitis, porcelain gall bladder and intrahepatic gall bladder. Apart from these, there are various other conditions where laparoscopic cholecystectomy may be very challenging .These include previous laparotomy and postoperative adhesions, portal hypertension, cirrhosis of liver and surgery in a pregnant patient. 2% to 31% of all cases of acute cholecystitis present preoperatively as empyema and gangrenous cholecystitis.[11] The gall bladder becomes thick walled, distended and friable. However, despite the higher conversion rate. Some of the studies have mentioned previous abdominal surgery as a

risk factor for increased conversion rates.[12] Surgery of the stomach and duodenum may make laparoscopic biliary surgery more difficult , particularly with dense adhesion in the triangle of Calot.[13] A gall bladder may congenitally be partially or completely embedded in the liver parenchyma or may become buried due to recurrent episodes of inflammation. The problem relating to this abnormality is an inability to grasp the fundus of the gall bladder and an absence of avascular plane of dissection between the gall bladder and liver parenchyma, which makes it technically a challenging task. Patients with a small contracted gall bladder or a trabeculated gall bladder due to heavy stone load and multiple criss cross strictures in the gall bladder lumen, are also candidates at risk where the surgeon would have difficulty in holding the gall bladder. A large calculus at the Hartmann's pouch or a stone at cystic duct and common bile duct junction may press the common bile duct causing obstructive jaundice or create a fistula between the cystic duct and common bile duct known as Mirizzi's syndrome . With experience the fistula can be repaired, the stone extracted, and the large cystic duct repaired laparoscopically, or a bypass may be needed necessitating conversion. 0.1% of all patients with gall stone disease would have Mirizzi's.[14] Extensive adhesions may make visualization of the biliary anatomy exceptionally difficult, consequently ligation or permanent injury of common bile duct may occur.[15] A heavy pathological liver seen in fatty liver and chronic hepatitis is also firm and is difficult to elevate and rotate . Even a flabby left lobe or an enlarged quadrate lobe may necessitate slight modification of the technique, and an extra access epigastric cannula may be needed for introducing a retractor to elevate the quadrate lobe. The elevated portal venous pressure and extensive collateral portosystemic shunts may cause troublesome bleeding during dissection of the cystic duct and artery. Although technically difficult, laparoscopy has become the preferred method of treatment in recent years.[16] The most dangerous and striking feature of the anatomy of the extra hepatic biliary tree is its variability. Variations of ducts, cystic artery, hepatic artery etc. are all common and even anomalies of the gall bladder are infrequently encountered. A congenital true duplication of the gall bladder, which has an incidence of 1 in 4000, may need special attention as it requires removal of both the lobes and rarely one of these twins may be intrahepatic. Various anomalous positions of the gall bladder have been described, which includes left sided, transverse, floating, intrahepatic and retrodisplaced gall bladder. The left sided gall bladder may or may not be associated with situs inversus . Whereas the cystic duct joins the common hepatic duct in the usual position, it is expected that there would be associated ductal and vascula ranomalies. Therefore while making special access ports one may consider intraoperative cholangiogram in case of any doubt regarding ductal anomalies. The hepatic artery crosses the hepatic duct posteriorly but in about 12% of cases, it may cross anteriorly. Caterpillar hump of right hepatic artery occurs in 6% to 16% of cases. After crossing the hepatic duct, the right hepatic artery often descends in the triangle of Calot to an area dangerously close to the cystic duct. This tortuous artery gives rise to multiple small branches supplying the gall bladder, which if severed inadvertently, may bleed profusely.

It would be useful to have some reliable predictive factors for conversion or complications in laparoscopic cholecystectomy. Patients can be selected for laparoscopic cholecystectomy and high-risk procedures and possible complications so that patients can be mentally prepared and can adjust their expectations accordingly.[17] Patients are informed preoperatively that if intraoperative complications such as uncontrollable bleeding or unclear anatomy, arise, conversion to open surgery will be necessary. It would be helpful to establish a criterion that could assess the risk for conversion preoperatively. The ability to accurately identify an individual patient's risk for conversion based on preoperative information can result in more meaningful and accurate preoperative counselling, improved operating room scheduling and efficiency, stratification of risk for technical difficulty, and appropriate assignment of resident assistance may improve patient safety by minimising time to conversion and helps to identify patients in whom a planned open cholecystectomy is indicated. Thus, for surgeons it would be helpful to establish criteria that would assess the risk of conversion preoperatively. This would be useful for informing patient and a more experienced surgical team could be assembled when risk for conversion appears significant.

Ultrasonography is the initial imaging method for diagnostic approach and evaluation of the biliary system, as it is widely available, non-invasive, safe, innocuous and non –expensive.[18] This method allows the detailed real-time study of the gallbladder, besides the evaluation of other findings that contribute to the final diagnosis. Ultrasonography has been able to reliably detect gallstones in greater than 90% of symptomatic patients and the measurement of the thickness of the gallbladder wall by ultrasound is accurate to within 1mm in 93% of patients.[19]

Abdominal Ultrasonography which is performed in the majority of patients has become a reliable, quick and noninvasive tool to diagnose gall stone disease.[20] Apart from its value in establishing the diagnosis, it may also predict the degree of difficulty involved in the procedure. One of the important findings is maximal gall bladder wall thickness of >4.0mm which indicates a contracted fibrotic gall bladder which is difficult to grasp[21] Apart from this the ultrasound may demonstrate a porcelain gall bladder, calcification of gall bladder wall and a gall bladder containing large stones; all of these are technically difficult due to inability to grasp and retract with standard laparoscopic instruments. Although a meta-analysis of diagnostic characteristics of ultrasonography published in1994 has revealed a sensitivity and specificity of 94% and 78% respectively but little data is available to assess its diagnostic value for the presence and severity of gallbladder inflammation.[22]

Gallstones are demonstrated ultrasonographically as intraluminal sound reflection that cast an acoustic shadow and show gravity dependence as the patient moved. Acoustic shadowing is not a function of the specific chemical composition of the gallstone. Therefore, cholesterol stones can not be distinguished from pigment stones with ultrasonography.[23] When the gall bladder is completely filled with stones, the lumen is not visualised. Only large acoustic shadow is evidence of stones in 20% of patients with lithiasis.[24] The progress in the treatment of gall stones is largely aided by well developed, sophisticated imaging modalities. Gray scale real time ultrasonography can demonstrate calculi in the gall bladder with the accuracy of 92 to 98%.[25] Such studies have led many to believe that the ultrasonography is the procedure of choice in making the diagnosis and should be performed routinely in the initial evaluation of patients with suspected gall stone disease. The smallest gall stones detectable by ultrasonography are about 0.5cm in diameter. Smaller stones can be shown provided that they are multiple.
It has been mentioned in previous studies, there are some factors which can be assessed preoperatively to reliably predict the feasibility of successful laparoscopic cholecystectomy or the requirement for the conversion to open cholecystectomy. Age above 60 makes laparoscopic cholecystectomy difficult.[26] Significantly high mortality and conversion rate has been reported in male sex. [27] It has been found that acute cholecystitis in obese has been the most important factor for conversion.[28] Ultrasound findings (gallbladder wall thickness, impacted stone) can used as predictors of potential operative difficulties when selecting patients for laparoscopic cholecystectomy. Clinically palpable gallbladder has been found to be a predictor of difficult laparoscopic cholecystectomy in a study. Upper abdominal surgery is reported to have high rate of conversion and attributed to dense adhesions. Knowledge of these factors may be used for the preoperative counselling of the patients regarding the successful outcome of the surgery as well as to predict the risk of conversion.

There are several clinical reports in the literature where relationship between preoperative ultrasound gallbladder wall thickness and the technical difficulty of a laparoscopic cholecystectomy is well established. Sharma SK et al in their study have noted the reasons for difficulties with more than 3mm gall bladder wall thickness. They noticed 6% had dense adhesions around gall bladder, 0.2% had unclear anatomy of Calot's triangle even after dissection, 13.3% had bleeding from liver bed and 11.7% had perforation of gall bladder during peeling from liver bed.

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Meticulous preoperative diagnostic technique is mandatory for planned laparoscopic gallbladder surgery to provide information for a rational selection of the most effective treatment and to avoid intraoperative difficulty and surprise. Therefore, sonography should play a central role in surgical planning. In our study, a checklist helped us to systematically record all relevant sonographic information and to convey it to the surgeon. The purpose to undertake this study was to evaluate preoperative ultrasound finding to predict or forecast a difficult cholecystectomy and how this would be beneficial in term of better management of patients. This study is useful to the laparoscopic surgeon in predicting a difficult cholecystectomy and a possible conversion from laparoscopic cholecystectomy to open laparoscopic cholecystectomy in a Government medical college environment.

REVIEW OF LITERATURE

Sharma SK et al[29] Department of surgery, Kathmandu medical college, Nepal, conducted a study to determine whether the pre-operative ultrasonography findings can predict the risk of conversion or difficulty during the laparoscopic cholecystectomy. 200 patients undergoing laparoscopic cholecystectomy were included. Sonographic parameters like size of gallbladder, wallthickness, distance between hepaticoduodenal ligament and hartmann's pouch and the size of stone were taken into consideration and difficulties in terms of adhesions around gallbladder, anatomy of calot's triangle and difficulty in peeling off gallbladder from the bed and retrieval were analysed. In 8 of 200 patients (4%), laparoscopic cholecystectomy was converted to open procedure. They concluded that all the sonographic parameters are statistically significant and thus sonographic signs can predict the difficulty in laparoscopic cholecystectomy.

Santambrogio R et al[30] in Italy, studied the technical difficulties and complications during laparoscopic cholecystectomy and its prediction by the pre-operative ultrasonography. From October 1993 to June 1995, a total of 143 patients with symptomatic cholelithiasis were evaluated by ultrasound the day before lap cholecystectomy. The ultrasonographic examination assessed six parameters: gallbladder volume, wall thickness, gallbladder adhesions, gallbladder neck position, gallbladder stone mobility, stone maximum size, on the basis of these a predictive judgement of technical difficulties was expressed by degree: easy, difficult and very difficult. Although 101 patients presented with uncomplicated symptomatic cholelithiasis and 42 had acute cholecystitis. The operation was predicted to be easy in 38% of cases, difficult in 49% and very difficult in 13% of cases. A significant association was found between stone mobility, presence of adhesions, and the difficulty of the procedure. The predictive ultrasonography evaluation was significantly correlated with some intraoperative steps; dissection of calot'striangle, dissection of gallbladder bed and intra-operative bleeding. They concluded that ultrasonography is a useful screening test for patients undergoing laparoscopic cholecystectomy and it can help predict technical difficulties.

Lal P et al[31] conducted a study in the Department of Surgery and the Department of Radiodiagnosis, Maulana Azad Medical College, New Delhi from March 1999 to April 2000 and included 73 patients. All patients with symptomatic gallstone diseases were included in the study. Pre-operative ultrasonography was performed on the morning of the surgery. Four ultrasonographic parameters were studied, namely gallbladder wall thickness, gallstone mobility, gallbladder size, common bile duct diameter. Of 73 cases, 17(23%) had to be converted to open, 10 cases were converted due to presence of adhesions around calot'striangle or surrounding structures. 1 case was converted due to presence of carcinoma of gallbladder. 2 cases were converted due to tear of cystic artery during dissection. 1 case was converted due to presence of empyema of gallbladder. 3cases were converted due to presence of sessile gallbladder hence inability to apply clips. 49(67.12%) laparoscopic cholecystectomies were performed without any difficulties. From this study they concluded that pre-operative ultrasonography is a good predictor of difficulty in laparoscopic cholecystectomy and should be used as a screening procedure.

Rizvi SAA et al[32] conducted a prospective study from June 2008 to July 2011 in Department of Surgery, Jawaharlal Nehru Medical College and Hospital, Aligarh Muslim University, Aligarh,.that included 298 patients who underwent elective laparoscopic cholecystectomy for uncomplicated gallstone disease. Logistic regression analysis defined only the sonographic sign of gall bladder thickness greater than 3 mm as a predictor of conversion. Ninety eight, out of total 298 patients, had gallbladder wall thickness of greater than 3 mm by preoperative ultrasonography and of these 46 (46.9%) had difficulty in dissection per-operatively and 20 (20.4%). A preoperative ultrasonographic evaluation for symptomatic cholelithiasis, which shows a thick gallbladder wall (≥3 mm) with calculi, is a sign of caution clinically for likely a difficult laparoscopic cholecystectomy procedure.

Sahu SK et al[33] conducted one prospective study over a period of 12 months in the Department of General Surgery at Himalayan Institute of Medical Sciences, HIHT University, Dehradun, Uttarakhand, India. Difficult Laparoscopic Cholecystectomy was defined in those procedures which exceeded 90 minutes in duration and or converted to open procedure. Out of 200 laparoscopic cholecystectomy 130 (65%) were easy and 70 (35%) were difficult. The maximum difficulty occurred while separating the adhesions 75.71% out of 70 cases. Maximum difficulty while performing this step of laparoscopic cholecystectomy was found in patients with Previous Abdominal Surgery 8 (50%). Maximum number of adhesions and difficulty separating them was seen in patients with acute cholecystitis 22 (41.50%). Out of 70 difficult cases there were 39 (55.71%) cases in which skeletonization, ligation and division of cystic artery and duct was difficult. Maximum difficulty in this step of laparoscopic cholecystectomy was seen in patients with abnormal callot's anatomy 20 (51.28 %). Maximum conversion rate was seen with patients having abnormal callot's anatomy 35%.

Nidoni R et al[34] conducted a prospective study from October 2010 to October 2014. Total of 180 patients meeting the inclusion criteria undergoing laparoscopic cholecystectomy were included in the study. Four parameters were assessed to predict the difficult laparoscopic cholecystectomy. These parameters were: 1) Gallbladder wall thickness; 2) Pericholecystic fluid collection; 3) Number of attacks; 4) Total leucocyte count. Out of 180 patients included in this study 126 (70%) were easy, 44 (24.44%) were difficult. It was found that patients with >2 attacks had significant high rates of difficulty (21.29% vs 84%) compared to patients with 2 and less than 2 attacks. Patients with total leucocyte count >11000/cu mm had significant high rates of difficulty (18% vs 77.77%) compared to patients with total leucocyte count <11000/cu mm. The sensitivity, specificity, positive predictive value and negative predictive value of total leucocyte count > 11000/cu mm in predicting conversion of laparoscopic cholecystectomy to open surgery are 80%, 83.52%, 22.22% and 98.61% respectively. It was found that patients with gall bladder wall thickness >3 mm had significantly high rates of difficulty (21.71% vs 75%). The sensitivity, specificity, positive predictive value and negative predictive value of gall bladder wall thickness >3 mm in predicting conversion of laparoscopic cholecystectomy to open surgery are 70%, 87.64%, 25% and 98% respectively. Patients with pericystic collection had significant high rates of difficulty (23.27% vs 80.95%). The sensitivity, specificity, positive predictive value and negative predictive value of Pericholecystic collection in predicting conversion of laparoscopic cholecystectomy to open surgery are 70%, 91.76%, 33.33% and 98.11% respectively.

Sharma N et al[35] conducted a prospective clinical trial in M.B. Govt. Hospital, Udaipur between March, 2014 and November, 2014. Abdominal sonography performed in 48 patients before cholecystectomy. Out of 48 patients with cholecystolithiasis on sonography, 26 patients had normal cholecystectomy (54.16%) and difficult cholecystectomy in 22 patients (45.83%). 22 patients had difficulties at cholecystectomy (45.83%) of whom (31.82%) has normal gall bladder wall thickness while (68.18%) had thick walled gall bladders. They faced adhesions in 90.91% of all those "difficult" procedures and they were dense and not easy to separate from the gall bladder and nearby structures and therefore required time for safe dissection to free theoperative field. The duration of a "difficult"

cholecystectomy was > 40 minutes. According to this study gall bladder wall thickness was an important predictor of difficulties during cholecystectomy. 22 patients had difficulties (41.67%) with gall bladder wall thickness greater than 3 millimeter.

Alamiri MH et al[36] conducted a prospective clinical trial in Department of Surgery, Al-yarmouk Teaching Hospital, between October 2010 and October 2012. Out of 122 patients with cholecystolithiasis on sonography, 87 patients had easy laparoscopic cholecystectomy (71.31%) and 27 patients had difficult laparoscopic cholecystectomy (22.13%).75 patients (61.47%)with gallbladder wall thickness ≤3 mm, 67 of them(89.33%) underwent easy laparoscopic surgery, five patients(6.66%) underwent difficult laparoscopic surgery. The other 47 patients (38.52%) were having gallbladder wall thickness >3mm. 20 of them (42.55%) underwent easy laparoscopic cholecystectomy, 22 patients (46.8%) underwent difficult laparoscopic cholecystectomy which was statistically significant.

Dinkel HP et al[37] conducted a prospective study Department of Diagnostic Radiology, University of Wurzburg, Germany. Upper abdominal sonography was performed in 75 consecutive patients before laparoscopic cholecystectomy. 19 had sonograms revealing gallbladder wall thickening (>4 mm); surgical preparation difficulties in 16 of these patients led to laparotomy in four patients. Sensitivity, specificity, positive predictive value, and accuracy of wall thickening as an indicator of technical difficulties were 66.7%, 94.1%, 84.2%, and 85.3%, respectively. Technical difficulties at laparoscopy occurred in all five patients with pericholecystic fluid on sonography (sensitivity, 20.8%; specificity,100%; positive predictive value, 100%; accuracy, 74.7%).

Memon MR et al[38] conducted a descriptive study at Ghulam Muhammad Mahar Medical College Hospital and Hira Medical Centre, Sukkur, from January 2006 to June 2010. The study included 1224 patients with symptomatic cholelithiasis, who underwent laparoscopic cholecystectomy. The mean age of patients was 45 years and male to female ratio 1:4. The mean operating time was 45 minutes and average hospital stay was 2 days. Out of 1224 patients, 8(0.65%) required open conversion. Factors responsible for difficult laproscopic cholecystectomy were dense adhesions in 3(0.25%), fibrosed gall-bladder with cholecystoduodenal fistula in 1(0.081%), common bile buct injury 1(0.081%), Mirizzi's syndrome 1(0.081%), and instrument failure as well as power breakdown with backup failure in 2(0.16%).

Khadim MG et al[39] conducted study to predict difficulty and conversion in laparoscopic cholecystectomy by sonography in the Department of Surgery of Al-Mawani General Hospital in Basrah, Iraq, between May 2005 and October 2008. It is found that the specificity of pericholecystic fluid was the most specific sonographic indicator for conversion in laparoscopic cholecystectomy (98.99%) , followed by gallbladder wall thickness more than 3mm (85.86%). Sonographic Murphy's sign predict conversion in (92.5%), then the sign of shrunken gallbladder (78.8%), the fifth indicator was the number of gallstone (69.7%), finally the gallstone size more than 1cm (58.7%).

Randhawa JS et al[40] conducted similar study to predict difficult laparoscopic cholecystectomy pre-operatively in Department of Surgery, Command Hospital (IAF),Bangalore between January 2005 to December 2006. On univariate and multivariate analysis, they found patients with body mass index >27.5 kg/m2,Palpable gallbladder, previous hospitalization and sinology wall thickness more than 4 mm were found statistically significant.

Kumar S et al[41] conducted a study on the factors predicting difficult surgery in laparoscopic cholecystectomy in the Department of General Surgery, Institute of Medical Sciences, Banaras Hindu University Varanasi . Univariate analysis showed that body mass index, fever at the time of attack, number of stones, number of attacks, previous history of acute cholecystitis, presence of tenderness, gall bladder wall thickness on ultrasonography and raised total leucocyte counts were significant for conversion. In low body mass index patients, 18(4.81%) patients were converted while 22 (15.94%) obese patients with high body mass index underwent conversion. Statistically, body mass index was found to be significant for risk of conversion (p =0.003). With evaluation of patients by ultrasonographic parameters, 82 patients (16%) had contracted gall bladder, and 430 patients (84%) had non-contracted gall bladder. In the contracted gallbladder group, 12 patients (14.63%) underwent conversion while in the non-contracted gallbladder group 28 (6.51%) underwent conversion. The difference between the two groups was not statistically significant (p>0.05). A total of 336 patients had normal wall thickness with a conversion rate of 2.98% as compared to 29.4% with thick gall bladder wall (p<0.05). The minimum wall thickness beyond which the risk of conversion increased statistically was 4 mm.

Zaman J et al[42] conducted a retrospective study at the Surgical Unit IV Civil Hospital Karachi, Pakistan from 15th July 2012 to 15th January 2013. A total of 129 patients were included in the study regarding preoperative findings, bleeding during dissection of the gall bladder from the liver bed was the commonest finding in study i.e. 35.7% followed by local adhesions 33.3% and perforation of gall bladder was observed in 7.8% cases. The frequency of difficult laparoscopic cholecystectomy in patients with thick walled gall bladder was higher in those patients whose per operative findings included local adhesions, perforation of gall bladder or bleeding during separation from liver bed in comparison with patients who did not have any of these per operative findings i.e. 25.6% versus 2.3%, 40% versus 7.6%, 15.2% versus 7.2% respectively. Rate of conversion to open cholecystectomy was highest in 51-60 years age group i.e. 20% and in female patients (10.9%). Rate of conversion to open cholecystectomy was highest (75%) in 5.1 to 6 mm wall thickness group. Rate of conversion to open cholecystectomy was highest (29.2%) in those patients whose duration of disease was greater than 5 years. Ultrasound for gall bladder wall thickness is a good predictor for difficult cholecystectomy and It should be used as anticipative measure for difficult cases.

De Lacey G et al[43] assessed the accuracy of oral cholecystography and ultrasonography in the diagnosis of gallbladder diseases. In the overall group of 500 patients both studies were found to be highly accurate in detecting calculus with a false-negative rates of 1 percent. Of the patients referred for oral cholecystography and ultrasonography, 143 had stone found by the two techniques.In four of the 143, stones were missed on oral cholecystography giving a false-negative rate of 2.87 percent in all patients shown to have stones. The ultrasonographic examination missed stones in six of the 143 giving false-negative rate of 4.3 percent.

Sengul S et al[44] conducted a study where 57 patients operated for gallstones were assessed preoperatively by ultrasonography. The number and diameter of gallstones, gallbladder wall thickness, gallbladder volume, ejection fraction, presence of sludge in the gallbladder and perivesical fluid, and common bile duct diameter were evaluated. The laparoscopic surgical procedure was evaluated in five different stages, which were scored individually by the surgeon. The degree of difficulty of the five stages of laparoscopic cholecystectomy was recorded using a visual analog scale score. A statistically significant correlation was found between the gallbladder wall thickness and all the stages (the degree of adhesion of the sac, dissection of Calot's triangle, dissection of the gallbladder bed, removal of the sac from the abdomen), except for access to the peritoneal cavity, and overall operational difficulty score (p< 0.05) A statistically significant difference was found between the gallbladder ejection fraction and all the stages except for access to the peritoneal cavity (p= 0.138), A statistically significant difference was found between the presence of sludge in the gallbladder and all the stages and overall operational difficulty score (p< 0.001) except for access to the peritoneal cavity (p= 0.565), and overall operational difficulty score (p< 0.006) Perivesical fluid and gall bladder volume abnormality did not reach statistical significance.

Thornton DJA et al[45] conducted a retrospective analysis of the case notes of 337 consecutive patients undergoing laparoscopic cholecystectomy in York District Hospital, UK between 1995 and 1999. They found diagnoses of jaundice, and elevated alkaline

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phosphatase and alanine transminase, previously identified markers for common bile duct stones to be factors predictive of future complications. Other factors previously implicated in the identification of common bile duct stones include > 10 stones on ultrasound, age > 55 years, and male sex. The results confirm that diagnosis of acute cholecystitis predisposes patients to complications pre-operatively. Of patients with acute cholecystitis, 20% subsequently require emergency surgery 9 with its higher complication rate, 2 due to gangrenous cholecystitis or peritonitis secondary to gallbladder perforation. Chosen risk factors – acute first presentation (p = 0.011), diagnoses of jaundice, acute pancreatitis, or acute cholecystitis (p = 0.023), and elevated alkaline phosphatase and alanine transminase (p = 0.001) – show statistically significant differences between our 2 groups, used in isolation, they do not provide sufficient sensitivity or specificity as a screening tool to predict pre-operative complications. In combination with hyperamylasaemia and small stones on ultrasonography, the presence of 2 or more predictive factors gives a sensitivity of 0.63, and specificity of 0.75, in the identification of patients at risk of further pre-operative complications requiring unplanned surgical review (p = 0.0002).

Husain A et al[46] laparoscopic cholecystectomy was performed in 108 patients at our hospital out of which 33 were males and 65 were females. Patients were divided into three groups of surgeries i.e. easy, difficult and very difficult surgery groups according to criteria for laparo¬scopic cholecystectomy. Difficult and very difficult groups were compared surgery (table 1). The mean age of patients was 47±1.2 years in case of surgeries completed in time peri¬od <60 min (easy cases), 52±2.3 in case of difficult surgeries (Time taken for surgery 60–120 min) and 53±0.7 years in case of very difficult surgeries. Table 2 shows data regarding various assessed factors. 19 cases (17%) categorized into dif¬ficult surgery were converted to open cholecystectomy. The factors contributing to open cholecystectomy were inability to correctly identify anatomy, biliary tract injuries, spillage of multiple stones, increased thickness of gallbladder and fi¬brosis of liver parenchyma. The present study assessed var¬ious operative predictors for laproscopic cholecystectomy and found that obesity, co-morbid diseases, previous history of acute cholecystitis or pancreatitis, delayed surgery after 72 hour of gall bladder inflammation, increased thickness of gallbladder, fibrosis of liver parenchyma, multiple stones, Size of calculi more than 1 cm are significant factors that result in difficult and very difficult surgical procedures.

Nachnani J et al[47] conducted a study in the Department of Surgical Gastroenterology, Seth GS Medical College and KEM Hospital, Mumbai. 105 patients (78 women) had a median age of 40 years (range 18 to 75). Difficulty in access to peritoneal cavity was encountered significantly more often in obese patients (p<0.05) and in patients with past history of upper abdominal surgery. Bleeding occurred more often in patients with previous upper abdominal surgery (p<0.05), those having gallbladder wall thickness exceeding 3 mm, and those with past history of acute cholecystitis or acute pancreatitis. Dissection of gallbladder bed was more often difficult in patients with past history of acute cholecystitis or acute pancreatitis (p<0.01) and in those with gallbladder wall thickness exceeding 3 mm (p<0.05). Difficulty in extraction was associated with a calculus size greater than 1 cm but not with number of stones.

Gupta G et al[48] Department of Surgery, MMIMSR, Mullana, Ambala, Haryana, India conducted a study on 50 consecutive patients who underwent laparo¬scopic cholecystectomy during 2013 to 2014. Patient's characteristics, clinical history, laboratory data, ultrasonography results and intraoperative details were prospectively analyzed to determine predictors of difficult laparo¬scopic cholecystectomy. Difficulty in access to peritoneal cavity was encountered significantly more often in male patients in comparison to females and in patients with advancing age. Difficulty in access to peritoneal cavity was encountered significantly more often in obese patients (p>0.05). Dissection of gallbladder bed was more often difficult in patients with increase in age 83.33% were in age group more than 60 years whereas in 60% of males dissection was found to be difficult in comparison to females (25%). It was also observed that in past history of abdominal surgery, dissection became difficult. Difficulty in extraction was there in 8 patients associated with large size stone impacted with thickened gall bladder i.e. wall thickness > 3mm for which port site was enlarged.

Suryawanshi PR et al[49] conducted a prospective study carried out at Department of General Surgery MGM medical college and hospital Aurangabad. Total 600 patients underwent laparo¬scopic cholecystectomy. 140 patients had difficult laparoscopic cholecystectomy. Most common age group was 31-40 yrs followed by 41-50yrs with 68 % female population. In ultrasonography 11.3% cases were having gall bladder wall thickening with 6-7% patients having impacted stone in Hartman's pouch and peri gall bladder fluid collection. Authors found a good correlation between ultrasonographic score and intra operative score score in accordance with reports in other studies. Stone impaction at the Hartman's pouch caused difficulty in holding the gallbladder during dissection. The thickened and contracted gallbladder was difficult to dissect because it had dense adhesions with the surrounding structures and in Callot's triangle.

Arumugam R et al[50] reviewed 80 cases admitted to Chennai Medical college Hospital & Research centre from September 2013 to June 2014 presented with upper abdominal pain, vomiting or dyspepsia are subjected to ultrasonographic evaluation.The following risk factors were evolved- age>50 years, male sex, H/O prior hospitalization for acute cholecystitis/ biliary pancreatitis, body mass index 25-27.5 and >27.5, abdominal scar, palpable gallbladder, wall thickening, impacted stone, and pericholecystic collection. Out of this body mass index >32.5, H/O prior hospitalization for acute cholecystitis, H /o previous abdominal surgery, gallbladder wall thickening > 3mm and pericholecystic collection were significant predictors of difficult laparoscopic cholecystectomy.

Haldeniya K et al[51] conducted a study on 500 patients undergoing laparoscopic cholecystectomy at Sawai Mansingh Medical College and attached Hospital. Sonographic parameters like Gall Bladder wall thickness, antero posterior diameter of Gall Bladder in fasting state, impacted gall stone, common bile duct diameter were taken into consideration and difficulties in terms of time taken for surgery, cystic duct injury; cystic artery injury and lead to conversion were analyzed. Of the 400 cases, 24 (6.0%) were converted to open procedure. Of the 144 (36%) cases predicted to be difficult, 116 (29%) were technically difficult, of which 18 (4.5%) were converted to open procedure. Of the 256 (64%) cases predicted to be easy on ultrasonography, 19 (4.75%) were found to be difficult on surgery, of which only 6 (1.5%) had to be converted to open procedure. In univariate analysis all the sonographic parameters we had included in this study were statically significant (p value <0.05).

Agarwal D et al[52] conducted a study in Department of General Surgery Mahatma Gandhi Medical College and Hospital, Jaipur from Aug 2013 to Aug 2015. In this study out of 292 patients we were found 72 patients as difficult gallbladder. Detailed study of these patients clearly shows that patient of male, higher side of age, increase duration of symptoms with multiple stone which are small in size have more chance of difficulty in laparoscopic cholecystectomy because these patients have more repeated attacks of cholecystitis silently or clinically detected previously. Pre-operative radiological investigations (ultrasonography, magnetic resonance cholangio pancreatography) are no doubt good predictors of difficult laparoscopic cholecystectomy. In ultrasonography 56% patient with gallbladder wall thickness >4cm had difficult laparoscopic cholecystectomy. 42% patient with Impacted stone at neck and 32% patient with contracted gallbladder had difficulty in laparoscopic cholecystectomy.

Jethwani U et al[53] conducted a study in Vardhman Mahavir Medical College & Safdarjung Hospital, New Delhi, India. A total of 200 patients presenting with symptomatic gall stone disease between January 2011 and June 2012 were included in the study. Prolonged operative time was statistically significant in cases with single large stone and thick-walled gallbladder (p < 0.05). Access to peritoneal cavity was difficult in seven cases mainly due to thick abdominal wall especially in the obese patients. Gall bladder dissection was difficult in 18.8% patients with previous lower abdominal surgery. Gangre-

nous gallbladder was the reason for difficult laparoscopic cholecystectomy. Bleeding during surgery was 17.7% in patients with thickened gall bladder than 8.38% in normal thickness gall bladder. A total of nine patients (55.5%) had contracted and fibrotic gallbladder of which four patients (44.4%) had to be converted. Male gender, single large stone, thick walled gallbladder, previous abdominal surgery and contracted gallbladder were the factors that proved to be significant in difficult cholecystectomy in this study.

Younis KK et al[54] conducted a prospective study on 150 patients who underwent Surgical wards of Al-Jamhoori Teaching Hospital between October 2009 to October 2010. Prospective analysis of different preoperative data including patient's age, gender, weight, height, previous abdominal surgery and previous attack of acute cholecystitis were done. The dependent variables (outcomes) included the duration of operation, bleeding, difficult accessing, bile leak, difficult dissection of gall bladder, and conversion to open cholecystectomy. The difficulties were met in 57(38%) patients. The mean duration of surgery was 79•83 ± 1•30 minutes. Factors contributed to difficult laparoscopic cholecystectomy were; male gender, previous upper abdominal surgery and BMI >35.

Ghazanfar S et al[55] conducted a prospective, non-randomized and descriptive study in Department of Surgery,Unit IV of Civil Hospital Karachi from December, 2010 to November 2012. Out of 64 patients, 4(6.3%) were males and 60 (93.8%) were females. Age ranged from 22-65 years with a mean of 40.45 ± 12.43 years. Gall bladder wall thickness ranged from 1-4.2 mm with a mean of 1.78 ± 0.80 mm. Difficult laparoscopic cholecystectomy was encountered in 13(20.3%). In patients with difficult laparoscopic cholecystectomy the mean gallbladder wall thickness was 2.40 ± 0.87 mm (p=0.001). The mean age of patients with difficult surgery was 40.54 ± 13.80 years. Mean operating time in patients with difficult laparoscopic cholecystectomy was 90.77±30.81 minutes as compared to 57.02 ± 20.63 minutes in normal laparoscopic cholecystectomy (p<0.001) This study identifies and corroborates with the international literature that gallbladder wall thickness of 3mm is associated with difficult cholecystectomy and higher rate of conversion to open cholecystectomy.

Gupta N et al[56] conducted a prospective study in the department of surgery, Lady Hardinge Medical College and associated Dr Ram Manohar Lohia Hospital, Delhi, India. The parameters considered in the preoperative scoring method were old age, male sex, history of hospitalization, obesity, previous abdominal surgery scar, palpable gall bladder, wall thickness of gall bladder, pericholecystic collection and impacted stone. A total of 210 patients were included in the study. They found that history of hospitalization, palpable gall bladder, impacted stone and gall bladder wall thickness were statistically significant factors for prediction of difficult laparoscopic cholecystectomy. Sensitivity and specificity of this preoperative scoring method were found to be 95.74% and 73.68% respectively. Positive predictive values of this scoring method were 90% and 88% for easy and difficult cases respectively. Area under ROC curve was 0.86. Conversion rate from laparoscopic to open cholecystectomy was found to be 4.28%.

Mohammad Aslam et al[57] Department of surgery, Jawaharlalnehru medical college, Aligarh Muslim University, Aligarh, India, studied the pre-operative prediction of a difficult laparoscopic cholecystectomy by ultrasonographic evaluation of cholelithiasis patients. A prospective study was conducted from december 2008 to september 2010 that included 149 patients who underwent elective laparoscopic cholecystectomy for uncomplicated gallstone diseases. They found that conversion to open can be predicted based on parameters available pre-operatively like thick gallbladder wall with calculi, infection and acute cholecystitis.

Leopold et al[58] undertook a study to asses the accuracy of gray-scale ultrasonography in the evaluation of cholelithiasis. The ultrasonographic and radiologic results were compared in the 75 patients with reliable visualisation or non-visualisation on the 2nd day oral cholecystography.There were 7 ultrasonographic errors in the 75 patients for an accuracy of 91 percent.

Stefan and Rosenquist[59] studying patients with and without gallbladder diseases in a double blind manner found that ultrasonography led to the correct diagnosis in approximately 90 percent of cases. Of their 141 patients, 18 had neither visualisation by oral cholecystography nor surgical confirmation.In the remaining 123 the ultrasonography diagnosis was correct in all, for an overall accuracy of 90 percent. There were 39 patients with cholelithiasis,30 of whom were correctly diagnosed by ultrasonography (778).Of the 9 false-negative ultrasonograms 6 had suboptimal echographic visualisation of the gallbladder. Excluding these 6 sub-optimal studies, the accuracy of ultrasonography for the detection of gallstones was 91 percent. There was one false-positive ultrasonography. In four patients the gallbladder could not be visualised by ultrasonography. Two of these patients had normal oral cholecystogram, while two had non-visualising oral studies and were not proven surgically.

Stanisica V et al[60] conducted a prospective cohort study of patients who underwent laparoscopic cholecystectomy from February 2005 to December 2009. Multivariate stepwise linear regression analysis showed that previous history of acute cholecystitis, gallbladder wall thickness >4 mm, acute cholecystitis to admission, size of calculus > 2 cm, > 5 attacks of pain that lasted longer of 4 hours, diabetes mellitus, duration of symptoms longer then 36 months and pericholecystic fluid collection were significant for prediction of difficulties of laparoscopic cholecystectomy. Difficulties during laparoscopic cholecystectomy were present at 185 (50.1%) patients. Difficulties during accessing peritoneal cavity were at 82 (22.2%) patients, difficulties in dissection of adhesiones of gallbladder GB with surrounding structures at 77 (20.9%) patients, difficulties at dissection of elements of Callot's triangle at 88 (23.8%) patients. Difficulties in dissection of the GB from the liver bed were present at 132 (35.7%) patients and difficulties in extraction of GB from abdominal cavity were present at 44 (11.9%) patients.Dissection of adhesions of the GB and surrounding structures was significantly more difficult in patients with more then five attacks of pain wich lasted longer than four hours ($p < 0.01$) and ultrasonographic confirmed adhesions of GB ($p < 0.01$) Difficulties in dissection of Calot's triangle elements were present in 88 (23.8%) patients and were significantly higher in fibrosis of gallbladder wall ($p < 0.01$), impacted stone of cystic duct or Hartmann recessus ($p < 0.01$) and C-reactive protein higher than 5 mg/L ($p < 0.05$). During dissection of gallbladder from the liver's tissue, difficulties were significantly higher in fibrosis of gallbladder wall ($p < 0.01$) and stones bigger than 2 cm. At 44 (11.9%) patients extraction of the gallbladder from the abdominal cavity was difficult. The difficulties were significantly more frequent in the gallbladder wall thickness bigger than 4mm.

Cwik G et al[61] reviewed the records of 5, 596 patients who underwent cholecystectomy between 1993 and 2011 in a single institution. A conversion to open cholecystectomy in patients with acute cholecystitis was necessary in 24 % (n=130) of the patients compared to 3.4 % of the patients with uncomplicated gallstone disease. The most frequent ultrasound findings in patients requiring conversion were a pericholecystic exudate in 42 %, a difficult identification of anatomical structures due to local severe inflammation in 34 %, and gallbladder wall thickening of>5 mm in 31 %. Additionally, when the duration of symptoms exceeded 3 days, more than half of the patients required conversion to open cholecystectomy and the conversion rate was fivefold higher than for those with a shorter duration of acute cholecystitis. In patients with severe acute cholecystitis found on ultrasound, combined with gallbladder wall thickening > 5 mm, pericholecystic exudates or abscess adjacent to the gallbladder, difficulty identifying anatomical structures within Calot's triangle, specifically when the duration of symptoms exceeds 3 days, cholecystectomy should be done as an open approach because of the high risk of conversion.

Nityasha et al[62] conducted a prospective study on 60 patients taken up for laparoscopic cholecystectomy for symptomatic cholelithiasis in Department of General Surgery, Pt B.D. Sharma PGIMS, Rohtak. History of acute cholecystitis was found to be highly significant predictor of difficulty in laparoscopic cholecystectomy (p<0.021). Six out of nine patients (66.7%) with a past history of acute cholecystitis

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had difficult surgeries, as compared to 14 of 51 patients (27.5%) who did not have such history. Upper abdominal tenderness at the time of surgery was found to be significantly associated with difficult operations (p=0.0084). 10 out of 17 such patients (58.8%) had difficult operations while 10 of rest 43 (23.3%) having no such sign at the time of surgery had difficult operation. Significant association was found between gall bladder thickness >3 mm and difficulty in laparoscopic cholecystectomy (p<0.0001). 17 out of 20 patients (85%) with thickened gall bladder wall presented difficulties during laparoscopic cholecystectomy as compared to only three out of 40 patients (7.5%) with normal gall bladder wall thickness. 19 patients had a contracted or distended gall bladder . 11 of these patients (57.9%) had difficult laparoscopic cholecystectomy as compared to 9 of other 41 patients (21.9%). This was found to be statistically significant (p=0.0060).

Singh AK et al[63] studied 80 cases of cholelithiasis admitted in the Department of Surgery, Jawaharlal Nehru Medical College Hospital, Bhagalpur (Bihar) in the period from January 2015 to December 2015 were studied. Among the eighty studied cases, twenty five cases were difficult cases. In twenty cases the operation was converted to open cholecystectomy procedure. Five cases were completed laparoscopically, but it took longer duration to complete the procedure. Among the difficult cases five cases were above fifty years. Out of twenty cases only four were females. History of long duration of stone was present in about 13 cases. Of the total twenty difficult cases 14 cases were obese. History of upper abdominal operations was present in 9 cases. Sonography showed thick wall of gall bladder in 7 cases. Gall bladder impacted with stone was present in 6 cases. C reative Protein was above > 220 mg /dl in 14 cases.

Malhotra et al[64] studied 51 randomly selected cases of gallbladder diseases. All 51 cases underwent surgery. The result of ultrasonography examination was compared with those of conventional radiology and operative findings. The diagnosis of gallstones was made when there was- a positive internal acoustic shadowing, identification of internal structures which layered dependently with gravity, gallbladder wall measuring more than 2.5 mm and failure of identifying the gallbladder lumen. Surgical exploration an histological study showed cholelithiasis in 58.83%, carcinoma gallbladder 15.69%, empyema gallbladder in 7.84% and others 17.64%. A comparison of ultrasonography with conventional radiography showed that ultrasonography provided evidence of disease in 50 cases(98.03%), with a false direct evidence in only one case. Conventional radiography provided direct evidence in only 8 cases(15.6%).Therefore , ultrasonography with its biggest advantage of examining and ruling out disease in other abdominal organs at the same sitting has therefore become the diagnostic tool of choice in the diagnosis of gallbladder diseases.

Garg P et al[65] conducted a study on patients undergoing laparoscopic cholecystectomy in Department of General and Laparoscopic Surgery at Dr. S.N. Medical College Jodhpur, India. Sensitivity of gall bladder wall thickness to predict difficulty in laparoscopic surgery was 37.5%, specificity 97.95%, positive predictive value 90%, negative predictive value 76.19% Sensitivity of gallbladder wall thickness to predict the conversion to open cholecystectomy was 41.18%, specificity 94.64%, positive predictive value 70%, negative predictive value 84.12%, Sensitivity of contracted gall bladder to predict the difficult laparoscopic cholecystectomy was 33.33%, specificity 93.88%, positive predictive value 72.73%, negative predictive value 74.19%. Sensitivity of contracted gall bladder to predict difficult laparoscopic cholecystectomy was 41.67%, specificity 89.28%, positive predictive value 45.45%, negative predictive value 80.64%. Sensitivity of stone impaction at the neck of gall bladder to predict difficult laparoscopic cholecystectomy was 41.67%, specificity 97.96%, positive predictive value 90.91%, negative predictive value 77.42. Sensitivity of the impaction of stone at the neck of gall bladder and conversion to open cholecystectomy was 41.17% and specificity 92.86%.

Vivek MAKM et al[66] conducted a study in Department of Surgery, Kasturba Medical College, Manipal University, and Mangalore. Total 323 patients were included. On analysis, elderly patients, males, recurrent cholecystitis, obese patients, previous surgery, patients who needed preoperative Endoscopic retrograde cholangiopanc reatography, abnormal serum hepatic and pancreatic enzyme profiles, distended or contracted gall bladder, intra-peritoneal adhesions, structural anomalies or distortions and the presence of a cirrhotic liver on ultrasonography were identified as predictors of difficult laparoscopic cholecystectomy. A scoring system tested against the same sample proved to be effective. A ROC analysis was done with area under receiver operator curve of 0.956. A score above 9 was considered difficult with sensitivity of 85% and specificity of 97.8%.

Lonare R et al[67] conducted a study on 100 patients of symptomatic cholelithiasis, requiring elective cholecystectomy, attending surgical out patient department of People's College Of Medical Sciences & Research Centre and other centre of Bhopal from January 2011 to 31st August 2015. Out of 100 patients only 18 of the patient were males rest 82 were female patients. The maximum incidence is seen in the age group of 35-40years. There were 18 patients with body mass index more than 27.5 kg/m2. Sensitivity of ultrasonograhic prediction is 55.55%. 18 patients had history of previous abdominal surgery. Positive predictive value of gallbladder wall thickness to predict the difficult laparoscopic surgery is 77.77%. Best clinical predictor for predicting conversion to open procedure is body mass index >27.5 (highest Chi-square value 6.46, P value 0.040). Best sonographic predictors for conversion to open cholecystectomy are impaction of stone at neck of gallbladder and contracted gallbladder (highest Chi-square value 13.6).

Bat O[68] reviewed patients who underwent laparoscopic cholecystectomy from 2010 to 2015 were retrospectively in Kanuni S.S. Training and Research Hospital, Istanbul, Turkey. According to intraoperative findings difficult laparoscopic cholecystectomy cases were described and classified. Class I difficulty: Adhesion of omentum, transverse colon, duode¬num to the fundus of the gallbladder. Class II difficulty: Adhesions in Calot's triangle and difficulty in dissection of cystic artery and cystic duct Class III difficulty: Difficulty in dissection of gallbladder bed (haemorrhage from liver during dissection of gallbladder, cirrhotic liver). Class IV difficulty: Difficulty in exploration of gallbladder due to intra abdominal adhesions including technical problems. A total of 146 patients were operated with difficult laparoscopic cholecystectomy. The most common difficulty type was Class I difficulty (88 patients/60.2%). Operation time was found to be related with conversion to open surgery (p<0.05). Wound infection rate was also statistically higher in conversion group (p<0.05).

Merdad AM[69] conducted one study where laparoscopic cholecystectomy was attempted in 847 patients, 823 (97.2%) werc completed laparoscopically and 24 (2.8%) had to be converted to open cholecystectomy. Acute cholecystitis was the commonest rcason for conversion (I3 out of 24 patients). Patients who had acute cholecystitis are five times at risk for conversion to open than other patients with non-acute cholecystitis (p<0.001). Age and sex were not statistically significant predictors for conversion. Reasons for conversion were thickened gallbladder wall and dense adhesions 13 (54.2%), unclear anatomy (including shortened cystic duct) 6 (25%), adhesions from previous surgery 2 (8.3%), severe bleeding 1 (4.16%), small bowel injury 1 (4.16%) and miscellaneous (Ca gallbladder) 1 (4.16%).

Abdel Baki et al[70] conducted a study on 40 patients with symptomatic cholelithiasis, normal liver function tests and non-dilated bile ducts. All patients underwent abdominal ultrasound examination prior to laparoscopic cholecystectomy. The total operative time ranged from 30-70 minutes with a mean of 51 ± 10.188 minutes. Prolonged operative time was statistically significant in cases with local signs of cholecystitis, single large stones, thick walled gall bladder and cases with liver fibrosis (p<0.05). Access to peritoneal cavity was difficult in 5 cases (12.5%) mainly due to thick abdominal wall in the obese patients. Gall bladder bed dissection was difficult in 4 cases (10%). It was significantly difficult in cases with liver fibrosis (p<0.05). Gall bladder extraction was difficult in 4 cases (10%) and extension of incision was attempted in only one case. The preoperative

parameters that significantly predicted difficult LC were based on the presence of local signs of cholecystitis in addition to the ultrasound criteria of liver fibrosis, large stones and thick wall gall bladder exceeding 3mm.

Witwit RJ et al[71] conducted a study where 221 patients were enrolled in the study, 177 female and 44 males with female to male ratio 4:1. The mean age of the patients was 38 year .six patients required conversion to open cholecystectomy with all over conversion rate 2.7%. In males the conversion rate was 4.5% and in female it was 2.2%. Conversion rate in the study is within the lower limits and accepted internationally. Dense fibrous adhesion is the main cause of conversion. History of acute cholecystitis is independent risk factor for conversion from laparoscopic to open procedure. Gender, age and history of jaundice or endoscopic retrograde cholangio pancreatography are not independent risk factor for conversion.

Tosun A et al[72] conducted a study on 176 patients who had undergone laparoscopic cholecystectomy. Mean age of the study population was 56.3 ± 16.2 years. Mean body mass index was 30.4 ± 7.3 kg/m2. In 19 (10.8%) subjects chronic cholecystitis was the diagnosis while acute cholecystitis was observed in 50 (28.4%) subjects. Other 107 (60.8%) subjects had choledocolithiasis. In correlation analysis gallbladder wall thickness (r = 0.167, p = 0.027), absence of fluid in gallbladder (r=0.210, p = 0.005), sludge in gallbladder (r = 0.230, p = 0.002), Stone in common bile duct (r = 0.198, p = 0.009), air in intra-hepatic bile duct(r = 0.279, p < 0.001), dilated common bile duct (r = 0.176, p = 0.02)were significantly correlated with the rate of conversion to open surgery. There were 65 (37%) subjects with thick gallbladder wall (>4 mm). Sonography revealed dilated common bile duct in 7(4%) subjects. Scoring significantly predicted failure in laparoscopic approach (AUC = 0.758, P = 0.003). Optimal cut off score was found to be 1.95 with 67% sensitivity and 78% specificity.

Reddy SVR et al[73] conducted a retrospective study was conducted on 457 patients out of whom 38 were converted to open cholecystectomies. 296 patients who underwent cholecystectomy were below the age of 60 years out of whom 9 had to be converted to open surgeries. 27 of 161 patients' above the age of 60 years were converted to open cholecystectomy, showing the age is one of the risk factors for conversion. There were a significant number of patients who were at a risk of myocardial infarction or had a previous history of myocardial infarction. Another significant comorbidity was previous surgery because of the presence of adhesions and acute cholecystitis. Gall bladder was also palpable in 36.8% of the converted patients and was the gall bladder thickness over 3mm was seen in 57.9% of the patients.

Tayeb M et al[74] conducted a case control study on patients who underwent laparoscopic cholecystectomy from January 1997 to December 2001 at Aga Khan University Hospital, Karachi, Pakistan. Conversion rate in this study was 7.5%. The final multivariate analysis identified two risk factors for conversion: Ultrasonographic signs of inflammation (adjusted odd's ratio 8.5% and 95% confidence level) and age >60years.

Vyas HG et al[75] reviewed 100 patients with diagnosis of Gall Stone Disease admitted to our surgical Unit between October 2011 and April 2013 for various pre-determined risk factors for difficult laparoscopic cholecystectomy. A gallbladder wall thickness of more than 4 mm was taken as a criterion for difficult laparoscopic cholecystectomy. 16 patients of the total had gallbladder wall thickened according to the criterion. Three of these patients finally underwent conversion to open method while in rest 13 patients intra-operative difficulty was noted [X2=60.43, P<0.05]. With reference to gallbladder volume, 9 patients of the total 100 had contracted GB on pre-operative ultrasonography. Seven of these had intra-operative difficulty while in the remaining two the procedure was converted to open method [X2=33.58, P<0.05]. Also, 15 patients had a stone size of more than 1.5cm on pre-operative ultrasonography. 9 of these patients had a difficult procedure, one had a conversion to open method while no difficulty was encountered in remaining 5 patients [X2=16.45, p<0.05].

Malik AM[76] conducted an observational descriptive study at Liaquat University Hospital, Jamshoro, Pakistan and various private hospitals in the same town from June 2011 to June 2013. Of the 936 patients, 839(89.63%) were females and 97(10.36%) were males with an overall mean age of 39.88±8.66 (range: 29-65 years). Of the total, 108(11.53%) patients presented with a solitary gallstone; the remaining 828(88.46%) had multiple gall stones. Besides, 297(15.34%) had complicated gall stone disease. Tenderness in the right hypochondrium was observed in 897(95.83%) patients, while tenderness with palpable, tender gallbladder with fever and leucocytosis in 39 (4.1%). Laparoscopic procedure was continued in 903(96.5%) cases despite having difficulties in dissection due to disturbed anatomy, but 33(3.52%) patients had to be converted to open cholecystectomy.

Costantini et al[77] conducted a retrospective study of 906 laparoscopic cholecystectomy for identification of preoperative risk factors leading to difficult laparoscopic cholecystectomy. 25 operations were converted (Conversion rate 2.76%). Factors significantly associated with conversion were age >60years, diabetes mellitus, previous supramesocolic abdominal surgery, ultrasound signs of cholecystitis, white cell count over 9000/dl, previous myocardial infraction, preoperative endoscopic retrograde cholangiopancreati cography and intraoperative adhesiolysis. (0.001 <p <0.05).

Patil S et al[78] conducted an observational study on 50 patients with upper abdominal discomfort and sonographic diagnosis of cholelithiasis. In this study prior history of hospitalisation (p<0.001), previous abdominal surgeries (p<0.01), palpable gall bladder (p<0.01), body mass index >27.5 (p<0.01), thickened gall bladder wall (p<0.001) were found to be significant predictors of difficult cholecystectomy. Remaining parameters like age, sex, impacted stone and pericholecystic collection were not found significant predictors of difficult cholecystectomy.

Chandak UA et al[79] conducted a prospective study from June 2012 to Nov 2014. 192 cases undergoing laproscopic cholecystectomy included in study at tertiary care hospital. Cholecystitis or pancreatitis and thickened gallbladder wall, preoperative endoscopic retrograde cholangiopancreaticography are found to be significantly associated with increased risk of conversion. Obesity (body mass index ≥30 kg/m^2) was significantly associated with difficulty in access to the peritoneal cavity. Clinical factors like male sex, previous acute cholecystitis or pancreatitis and ultra sonographic finding of gall bladder wall thickness ≥4 mm can help to predict difficult laparoscopic cholecystectomy and likelihood of conversion of laparoscopic cholecystectomy to open cholecy stectomy.

Acharya A et al[80] conducted a prospective study on 114 cases with 91(80%) females and 23(20%) males. Out of all 72% were predicted easy and 28% difficult preoperatively, whereas 63% turned out to be easy and 37% difficult respectively during surgery. Prediction came true in 85.36% for easy and 93.75% for difficult cases. The most important parameters that make the procedure difficult are h/o cholecystitis within 6 months (p=0.001), recurrent pain abdomen (p=0.001), gall bladder thickness (p=0 .001), impacted Stone (p=0.001). Sensitivity was 71.42% and Specificity was 97.22% whereas positive predictive value 93.75% and negative predictive value was 85.36%.

AIMS AND OBJECTS

To evaluate the technical difficulties and complications during laparoscopic cholecystectomy and its prediction by pre-operative ultrasonography.

MATERIALS AND METHODS

Study design: A longitudinal study.

Study set-up: In the Department of Surgery, Regional Institute of Medical Sciences, Imphal, Manipur.

Study duration: Data collection will be carried out for two calendar

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years with effect from September 2014 to August 2016.

Study population: Cases admitted as in patient in various surgical wards in RIMS Hospital, Imphal, for cholelithiasis, who are clinically evaluated and confirmed by ultrasonography.

Inclusion criteria: The patients aged between 16 to 60 years having cholelithiasis diagnosed by ultrasonographic examination in various surgical wards of RIMS Hospital, Imphal.

Exclusion criteria:
1. Patients with features of obstructive jaundice.
2. Patients with common bile duct calculus, raised alkaline phosphatase, where common bile duct exploration was needed.
3. Patients refusing surgery.
4. Patients not willing for laparoscopic cholecystectomy.

Sample size: The sample size calculation was done using following formula: N = Z2SN (1-SN)/W2, where N= sample size, Z=constant (1.96), SN=sensitivity (80%), W=error (5%).On substituting values, N=245.86, but, due to the limited time we could collect two hundred (200) cases of cholelithiasis that fulfill the inclusion criteria.

Study variables: Prediction of the technical difficulties encountered during laparoscopic cholecystectomy and complications thereof will be done using some of the ultrasonographic findings of the patients, namely

1. Gallbladder wall thickness (more than 4-mm thick gallbladder wall thickness was predicted to be a difficult laparoscopic cholecystectomy)
2. Gallstone mobility (gallstone impacted at the neck of the gallbladder was taken to be a difficult laparoscopic cholecystectomy)
3. Gallbladder size (contracted gallbladder was predicted to be a difficult laparoscopic cholecystectomy) and
4. Common bile duct diameter. (Common bile duct size more than 6mm was predicted to be difficult laparoscopic chole cystectomy).

The operative criteria:
1. More than 90mins taken for laparoscopic cholecystectomy from insertion of the veres needle or trocar (in open method of port insertion) until the extraction of gallbladder, was considered a difficult laparoscopic cholecystectomy.
2. Tear of gallbladder during dissection with spillage of bile and stones was considered a difficult laparoscopic cholecystectomy.
3. More than 20mins taken to dissect the gallbladder from the gallbladder bed was considered a difficult laparoscopic cholecystectomy.
4. More than 20mins taken to dissect calot's triangle was considered a difficult laparoscopic cholecystectomy.
5. Any laparoscopic cholecystectomy converted to open was considered a difficult laparoscopic cholecystectomy.

Outcome variables: All cases underwent laparoscopic cholecystectomy with assessment of the difficulties encountered in terms of:
1. Duration of surgery (in minutes): Duration of surgery included the time from insertion of Veress needle to closure of the trocar insertion site and was evaluated as a continuous variable.
2. Tear of gallbladder during dissection with spillage of bile and stones
3. Gallbladder bed dissection: The operating surgeon described gallbladder bed dissection as "easy" or "difficult".
4. Difficult calots triangle: duration of time taken to dissect calots triangle is described as easy or difficult.
5. Conversion to open cholecystectomy.

Working definition:
Difficult laparoscopic cholecystectomy:
Ultrasonographically, laparoscopic cholecystectomy is predicted to be difficult when gallstones are associated with other findings like gallbladder wall thickness more than 4mm, gallstone impacted at the neck of gallbladder, contracted gallbladder, and common bile duct diameter more than 6mm.

Intraoperatively, difficult laparoscopic cholecystectomy is defined as time taken from insertion of the veres needle or trocar (in open method of port insertion) until the extraction of gallbladder >90minutes, tear of gallbladder during dissection with spillage of bile and stones, time taken to dissect the gallbladder from the gallbladder bed >20minutes, time taken to dissect calot's triangle >20minutes and any laparoscopic cholecystectomy converted to open.

Study tools :
1. High definition LCD laparoscopic monitor, model no- OEV261H, Olympus Medical System Corp; made in Tokyo, Japan 2013.
2. SonoAce X8 ultrasound system, Samsung Medison Co. Ltd, made in Korea, screening done with sectoral probe with frequency of 3.5MHz 2013.

Procedure:
(1) Informed and written consent will be taken from parents/ guardians for participation in this study. A pre-designed proforma will be used to gather information of the subject of study.
(2) The cases showing ultrasonographic finding of stone in GB are taken up for study.
(3) Data of the cases will be recorded in a prescribed proforma designed for the study purpose.

Laparoscopic cholecystectomy:
The patient is positioned in supine position and after asepsis, the patient is draped with sterile draper with operating surgeon on the left of the patient, assistant on the right with camera assistant on the left of the patient with monitor on the right of the patient. Pneumoperitoneum is created by closed veress needle technique where verees needle is inserted transumbilically perpendicular to the abdomen with tip facing the pelvis while upward traction is maintained on the abdominal wall with towel clips.

Aspiration test or water drop test was performed to ascertain the verees needle inside the peritoneal cavity. Open surgical hasson cannula technique was used as an alternate access to gain entrance to the abdomen. Intra abdominal pressure was maintained at 12 to 14mm Hg and patients pulse and blood pressure was closely monitored during the early phase.

Two 10mm ports, (1camera port in umbilicus and 1 working port in epigastrium), two 5mm port (1 working port in subcostal in the midclavicular line for surgeons left hand and 1 at the level of umbilicus in anterior axillary line for retracting gall bladder). Except for the camera port all other ports are inserted under direct visual control. Suction, diathermy, hook scissors are also introduced through the epigastric port as and when required.

After complete diagnostic survey of the intra abdominal cavity patient is positioned in reverse trendelenberg position approximately 20 to 30 degrees and turn the operating table to left.

Calots triangle was opened up by cranial traction of fundus with anterior axillary grasper directing towards the tip of shoulder and lateral and caudal traction of the infundibulum of the gallbladder with the left hand surgeons grasper and places the structers in tension. As per requirement of dissection infundibular grasper were retracted laterally to expose the anterior aspect of calots and retracted anteromedially to expose cystic pedicle. Dissection was initiated directly adjacent to the gallbladder, any adhesion to the gallbladder was taken down. Cystic duct and cystic artery was identified and skeletonised before application of the clips separately. Three clips applied on the cystic duct, one nearby gallbladder and two nearby common bile duct and duct was cut and divided between clips. Normally one clip was applied at the cystic artery and cut by harmonic scalpel.

Gallbladder was dissected off from the gallbladder bed of the liver using harmonic scalpel and blunt dissection, prior to complete detachment of the gallbladder from liver bed was reinspected for adequate homeostasis or bile leak. Gallbladder was removed from epigastric port . for distended gallbladder ,neck of the gallbladder is opened up outside the abdomen and suction cannula introduced to suck out the bile and packed stones removed with Desjardins stone holding forceps with or without fascial incision to extent and facilitate gallbladder removal. Peritoneal cavity irrigation and final inspection were done and drain was placed through axillary port in the morrisons pouch when hemorrhage or bile leak was suspected. Fascial closure was done for all the 10mm port siites and skin closed with absorbable 000 sutures.

There were 8 patients who had bile spillage intraoperatively and developed port site infection post operatively which was managed conservatively with 2-3 dressings.

Statistical analysis:
Data will be entered in a statistical software package. Descriptive statistical analysis will be carried out using SPSS 21, IBM Corp, Chicago, Il. Descriptive statistics will be presented as mean, median, standard deviation, frequency and percentage. The p-value of less than 0.05 will be taken as significant. Predictor variables for difficult laparoscopic using ultrasonography will be compared with intraoperative findings. Correlation will be calculated, predictive power, sensitivity and specificity of ultrasonography in predicting difficult laparoscopic cholecystectomy will be calculated.

Ethics issues:
The study will be carried out after obtaining approval from the Institutional Ethics Committee (IEC), Regional Institute of Medical Sciences, Imphal. The confidentiality of the respondents shall be maintained by not linking personal identities with data and the accessibility of interview schedule will be restricted only to the study investigator.

Conflict of interest:
None.

RESULTS AND OBSERVATIONS

This longitudinal study was conducted among 200 patients with cholelithiasis admitted in RIMS Hospital, Imphal during September 2014 to February 2016. The following observations were made.

Table 1: Distribution of respondents by age

Age in years	Frequency	Percentage
<30	24	12.0
31-40	89	44.5
41-50	53	26.5
51-60	34	17.0
Total	**200**	**100.0**
Mean ± SD	**36.4 ± 7.9**	

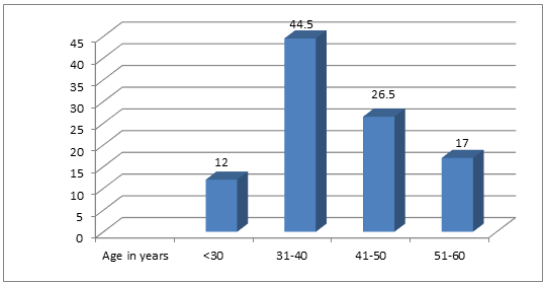

Figure 1: Bar diagram showing age distribution of respondents

The above table and figure show that majority of the patients were from the age group 31-40 years which constituted 44.5% of cases followed by 41-50 years group (26.5%), 51-60 years age group (17%) and less than 30 years age group constituted only 12%.

Table 2: Distribution of respondents by gender

Sex	Frequency	Percentage
Females	146	73.0
Males	54	27.0
Total	**200**	**100.0**

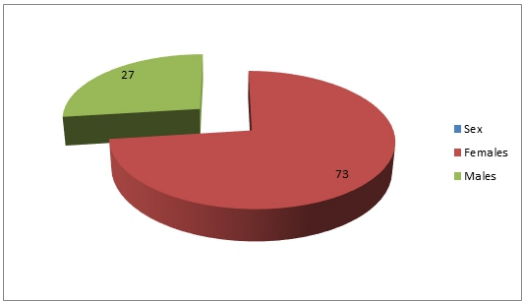

Figure 2: Pie chart showing age distribution of respondents

Most of the patients were females i.e. 73.0% as shown in table 2 and pie chart above.

Table 3: Distribution of respondents by religion

Religion	Frequency	Percentage
Hindu	107	53.5
Christian	74	37.0
Muslim	19	9.5
Total	**200**	**100.0**

Hindu constituted more than half of the patients (53.5%) and Muslim constituted only 9.5% of cases as shown in table 3 above and figure 3 below.

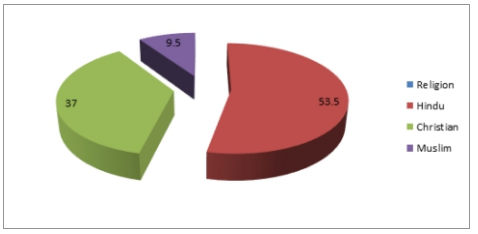

Figure 3: Pie chart showing distribution of respondents by religion

Table 4: Distribution of respondents by address

Address	Frequency	Percentage
Urban	136	68.0
Rural	64	32.0
Total	**200**	**100.0**

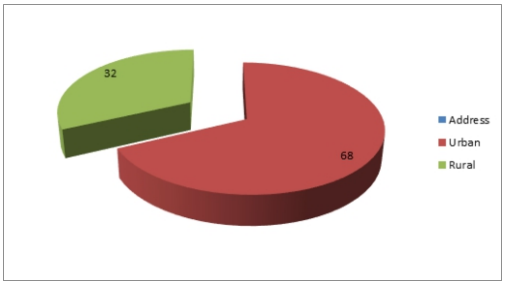

Figure 4: Pie chart showing distribution of respondents by address

Most of the patients were from urban areas (68%) than the rural areas

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(32%) as shown in table 4 and figure 4.

Table 5: Distribution of respondents by type of activity based on occupation

Type of activity	Frequency	Percentage
Sedentary	101	50.5
Moderate	64	32.0
High	35	17.5
Total	**200**	**100.0**

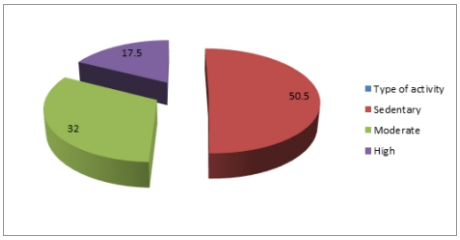

Figure 5: Pie chart showing distribution of respondents by type of activity

Half of the respondents were having sedentary life style as shown in table 5 and figure 5.

Table 6: Distribution of respondents by presenting complains

Symptoms	Number	Percentage
Pain	200	100.0
Flatulent dyspepsia	141	70.5
Nausea and vomiting	123	61.5
Appetite reduced	105	52.5
Fever	57	28.5
Mass per abdomen	42	21.0
Altered bowel habits	33	13.5

Abdominal pain was present in all the patients, flatulent dyspepsia was present in 70.5% of cases, nausea and vomiting in 61.5% of cases and mass per abdomen in 21% of cases.

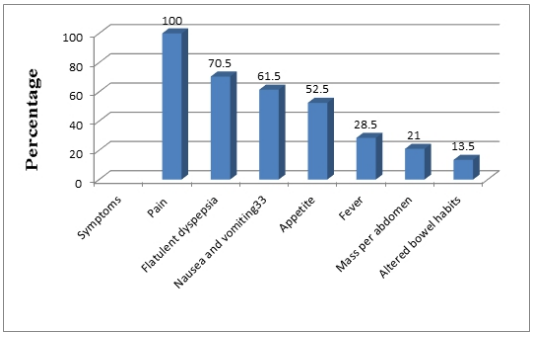

Figure 6: Bar diagram showing distribution of respondents by presenting Complains.

Table 7: Distribution of respondents by important biochemical findings

Important biochemical variables	Findings	Percentage
Haemoglobin	13.6 ± 2.9	
WBC ≤10,000cumm 10-20000cumm >20000cumm	98 102 0	49.0 51.0 0.0
Urine Albumin (present) Sugar (present)	5 12	2.5 6.0

Mean haemoglobin was 13.6 mg% with a standard deviation of 2.9. Half of the respondents had TLC of 10-20000 cum and urine sugar was present in 6.0 % of cases.

Table 8: Distribution of respondents by ultrasound findings

Ultrasound findings	Frequency	Percentage
Only Gallstone	127	63.5
Gallstone with other findings	73	36.5
GB wall thickness >4mm	22	11.0
Gall stone impacted at the neck	31	15.5
Contracted GB	13	6.5
CBD diameter >6mm	7	3.5
Total	**200**	**100.0**

Only gallstone (mobile) was found in 63.5% of the patients and gallstone with other findings was found in 36.5% of cases; GB wall thickness >4mm (11%), Gall stone impacted at the neck (15.5%), contracted GB (6.5%) and CBD diameter >6mm (3.5%).

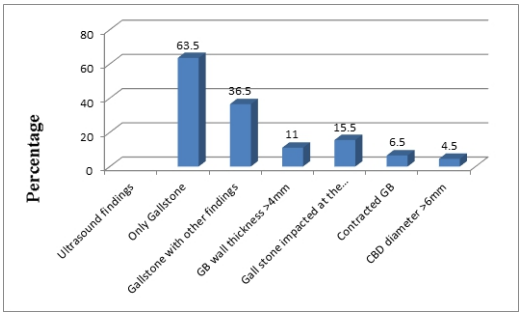

Figure 7: Bar diagram showing distribution of respondents by ultrasound findings

Table 9: Relation between ultrasound findings and technical difficulties of laparoscopic cholecystectomy

Ultrasound findings	Laparoscopic cholecystectomy		Total	Chi-square test (p-value)
	Difficult (%)	Easy (%)		
Gallstone with other findings (%)	46 (63.1) True positive = A	27 (36.9) False positive = B	73 (36.5%)	Value=34.84 p-0.00001
Only gallstone (%)	27 (21.26) False negative = C	100 (78.74) True negative = D	127 (63.5%)	
Total	**73 (36.5)**	**127 (63.5)**	**200 (100.0)**	

Patients with only gallstone had difficult cholecystectomy 21.26% of cases but 63.1% of patients with other ultrasound finding had difficult cholecystectomy. This finding is found to be statistically significant ($p<0.05$).

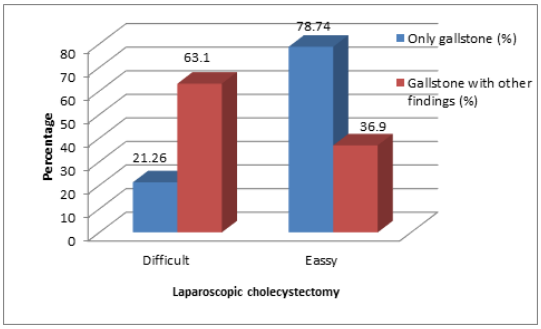

Figure 8: Bar diagram showing relation between ultrasound findings and technical difficulties of laparoscopic chole cystectomy.

Therefore,

Sensitivity (of getting difficult cholecystectomy because of various ultrasound findings)

$$\text{Sensitivity} = \frac{A}{A+C} \times 100 = 46/73 = 63.01$$

Positive predictive value

$$\frac{A}{A+B} \times 100 = 46/73 = 63.01$$

Table 10: Relation between ultrasound findings and pattern of laparoscopic cholecystectomy.

Ultrasound findings	Difficult cholecystectomy (%)	Easy Cholecystectomy (%)	Total (%)
GB wall thickness >4mm	14 (63.6)	8 (36.4)	22 (100.0)
Gall stone impacted at the neck	20 (64.5)	11 (35.4)	31 (100.0)
Contracted GB	8 (61.5)	5 (38.5)	13 (100.0)
CBD diameter >6mm	7 (100.0)	0 (0.0)	7 (100.0)
Total	**46 (63.0)**	**27 (37.0)**	**73 (100.0)**
Chi-square test p-value	**Value =3.83 P=0.280**		

All cases with common bile duct diameter >6mm were difficult and 6 of them were converted to open. Around 60% in each of the other ultrasound findings were having difficult cholecystectomy. There is no statistical difference in between the groups in relation to difficulty of cholecystectomy (p>0.05).

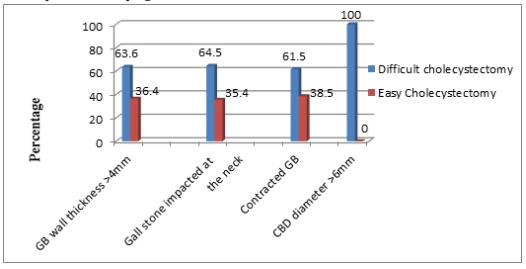

Figure 9: Bar diagram showing relation between ultrasound findings an pattern of laparoscopic cholecystectomy.

Table 12: Complications which lead to difficult Laparoscopic cholecystectomy

Complications	Number	Percentage
Dense adhesions at Calot triangle or the surrounding structures	23	56.0
Anomaly of gallbladder	2	4.8
Tear of cystic artery during dissection	10	24.4
Empyema of gallbladder	3	7.3
Sessile gallblader	3	7.3
Total	**41**	**100.0**

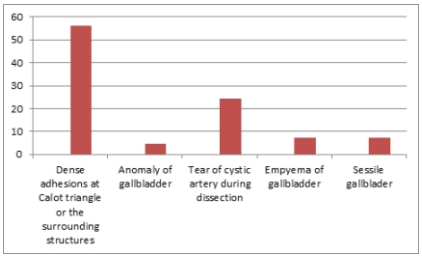

Figure 10: Bar diagram showing complications in difficult laparoscopic Cholecystectomy

Table 13: Distribution of respondents by operative timing

Operative timing	Frequency		Total (%)	Chi-square test p-value
Time taken from insertion of trocar to GB extraction	Gallstone with other findings (%)	Only gallstone (%)		
≤ 90 minutes	38 (52.0)	112 (88.2)	150 (75.0)	Value=41.557
>90 minutes	35 (48.0)	15 (11.8)	50 (25.0)	p-0.00001
Dissection of GB from GB bed	56 (76.7)	118 (92.9)	174 (87.0)	Value=10.758
≤ 20 minutes	17 (23.3)	9 (7.1)	26 (13.0)	p-0.001
>20 minutes				
Dissection of Calots' triangle	59 (80.8)	120 (94.4)	179 (89.5)	Value=9.213
≤ 20 minutes	14 (19.2)	7 (5.6)	21 (10.5)	p-0.002
>20 minutes				
Total	**73 (100.0)**	**127 (100.0)**	**200 (100.0)**	

This table shows that time taken in all the three parameters is more than expected in gallstone with other findings than only gallstone group and the findings are found to be significant (p<0.05).

Table 14: Table showing incidence of postoperative complications.

Post operative complications	Number of cases
Wound Infection	8
Hemorrhage	0
Retained stone	0
Bile leak	0
Prolonged Ileus	0

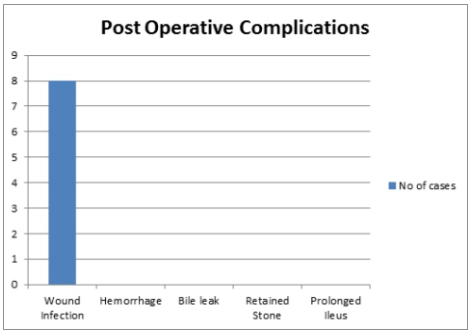

Figure 14: Bar diagram showing incidence of postoperative complications.

DISCUSSION

Age distribution

Majority of the patients in this study is in the age group of 31-40 years, whereas in the study conducted by Muhammad Rafique Memon et al, the majority of them were in the mean age group of 45 years. In the study conducted by Jaskiran Randhawa JS et al majority of the patients were in the age group of (30-50) years with the mean age of 44.37 years. In another study conducted by Khadim GM et al, the majority of the patients were in the age group of (40-50) years. In a study conducted by Saber A et al, majority were in the age group of <50 years.

Sex Distribution

In the present series, out of 200 patients, 146(73%) are females and

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54(27%) are males. The study conducted by Thornton DJA et al, 72.10% patients were females and 27.89% patients were male. A study was conducted by Rizvi SAA et al who found majority of the patients were female (76.51%), which is in accordance with the present study. Similar sex distribution was seen in the study conducted by Aslam M et al.

Presenting symptoms

Pain

Pain is the predominant symptom of all the 200 patients in the present study. In a study conducted by Kumar S et al found that 35.5% patients had acute attacks and rest had history of dyspeptic symptoms. He also found that patients having such history of acute attacks had a significant higher rate of difficult laparoscopic cholecystectomy (15.6% vs 3.6%) than those with dyspeptic symptoms.

Flatulent Dyspepsia

In the present study, out of 200 patients, 141(70.5%) patients presented with flatulent dyspepsia. It is in accordance with the study conducted by Kumar S et al, where 64.5% patients presented with the same complaint.

Nausea & Vomiting

In the present study, 123 (61.5%) patients presented with complaints of nausea & vomiting off and on. Vomiting was spontaneous and occurred mostly during the attacks of pain.

Loss of appetite

In our study, 105(52.5%) patients have history of loss of appetite. It is not associated with significant loss of weight.

Fever

Fever is present in 57(28.5%) patients, which is of moderate degree and is not associated with chills and rigor.

Mass per abdomen

In this study, 42(21%) patients presented with palpable lump in the right hypochondrium. It was not associated with jaundice.

Altered bowel habits

In the present study, 33(13%) patients presented with altered bowel habits. It was not associated with any blood in stool.

Investigations

Routine haematological and biochemical investigations like haemoglobin, total leukocyte count, urine examination, random blood sugar, serum creatinine, blood urea, liver function test are done in all cases.

Haemoglobin of the patients ranged from 10.7 to 16.5 gm%. Serum creatinine and blood urea are within the normal limit for all the patients.

In this study 51% of patients have total leukocyte count within the range of 10,000 to 20,000/cu mm. According to Nidoni et al patients with total leucocyte count >11000/cu mm had significant high rates of difficulty (18% vs 77.77%) compared to patients with total leucocyte count <11000/cu mm.The sensitivity, specificity, positive predictive value and negative predictive value of total leucocyte count > 11000/cu mm in predicting conversion of laparoscopic cholecystectomy to open surgery are 80%, 83.52%, 22.22% and 98.61% respectively.

Ultrasonography

Ultrasonography was done as a routine investigations in all the patients. The sonologic criteria to diagnose gallstone were acoustic shadowing of the opacities seen in the gallbladder and its change of position with the change in patient position.

In this study out of 200 patients, 127(63.5%) patients have only gallstones and 73(36.5%) patients have ultrasound findings of gallstones associated with other findings in gallbladder. Out of these 73 patients, 11% patients have gallbladder wall thickness more than 4mm; 15.5% patients have gallbladder stone impacted at the neck; 6.5% patients have contracted gallbladder; 3.5% patients have common bile duct diameter more than 6mm. Study conducted by Haldeniya K et al there were 156 (39%) patients with gall bladder wall thickness more than 3mm,144 patients (36%) with contracted/distended gallbladder. There were 88 (22%) patients with gall stone impacted at the neck of gall bladder or Hartman's pouch.

In our study gall bladder wall thickness more than 4mm leads to difficult laparoscopic cholecystectomy in 63.6% cases. In Study conducted by Sandhu G et al patients having thick gallbladder wall with easy outcome were 1(20.0%), while 4(80.0%) had difficult outcomes. In another study conducted by Aslam M et al, 49 patients out of 149 patients had gall bladder wall thickness more than 3mm and 46.9% patients had difficult laparoscopic cholecystectomy.

In our study, 13 patients have contracted gallbladder and 61.5% of them had undergone difficult laparoscopic cholecystectomy. It is in accordance with the study conducted by Nachnani J et al and Lal P et al who founded significant correlation between the contracted gallbladder size and difficulty in its dissection laparoscopically.

In the present study, 7 patients had common bile duct dilated more than 6mm and all of them had to undergo difficult laparoscopic cholecystectomy. In the study conducted by Lal P et al, significant correlation was established between dilated common bile duct and difficult laparoscopic cholecystectomy.

In our study, time taken from insertion of trocar to gallbladder extraction is more than 90mins in majority of cases (48% vs 11.8%) with ultrasound findings of gallstones associated with other findings than the cases with ultrasound findings of gallstones only. These cases are considered as difficult laparoscopic cholecystectomy in the present study. Similar study conducted by Randhawa JS et al also considered the cases with operative time 60 to 120 mins as difficult laparoscopic cholecystectomy.

Post operative treatment

In all the cases post operative treatment included the following;

a) Nill per orally till patients recovered from post operative ileus evidenced from appearance of bowel sounds and passage of flatus.
b) Iv fluids continued till oral liquid diet was started.
c) Single dose of prophylactic antibiotics was given.
d) Analgesics as and when required

Intra operative complications which led to difficult laparoscopic cholecystectomy; majority of cases (56%) had dense adhesions at calots triangle and surrounding structure which led to difficult laparoscopic cholecystectomy. This is followed by tear of cystic artery during dissection which accounted for 24.4% of patients. There were 3 patients with sessile gallbladder. There were 2 patients showing anomalous gallbladder 3 patients with empyema gallbladder. In the study conducted by Zaman J et al,33.3% patients had adhesions near the calots triangle and its surrounding structures.

Post operative complications

Only 8 patients had infection of the epigastric port site which required 2 to 3 dressings. It healed by secondary intension. In the study conducted by Saber A et al the incidence of wound infection, whether port site or laparotomy was 18/204 (8.82%), 10 of them were males (11.3 % of total male patients) and 8 females (6.9% of total female patients).

Follow-up

All patients were followed up for 6 months and no significant

complications are noted.

CONCLUSION

The highest incidence of gallatone in the present study is in the age group of 31 to 40 years, followed by 41 to 50 years and 51 to 60 years. The sex ratio (female: male) is 2.7:1. This clearly shows female preponderance, which is same all over the world. Endogenous estrogen and progestins are attributed to this phenomenon.

In this study, almost half (50.5%) of the respondents were having sedentary life style, which is same all over the world.

Pain was the predominant symptom seen in all (100%) patients in this study. This is followed by flatulent dyspepsia (70.5%) and vomiting (61.5%). 28% patients had fever and 21% presented with palpable mass per abdomen.

Ultrasound is the most accurate and sensitive investigation for the diagnosis of cholelithiasis.

Out of 200 patients, all patients had stones in the gallbladder. 73 patients had other associated findings along with gallbladder stones. Out of 73 patients, 22patients had gallbladder wall thickness more than 4mm, 31 patients had gallstones impacted at the neck of gallbladder, 13 patients had contracted gallbladder, and in 7 patients common bile duct was dilated (>6mm).

The positive predictive value of difficult laparoscopic cholecystectomy is 63.01%. In this study, gallbladder wall thickness more than 4mm, gallstones impacted at the neck of gallbladder, contracted gallbladder, and common bile duct diameter more than 6mm were significant predictors of difficult laparoscopic cholecystectomy. The incidence of port site infection was 4% and in all the cases, there was biliary spillage. No complications like common bile duct injury, or injury to adjacent viscera occurred in our study.

According to the operative criteria of difficult laparoscopic cholecystectomy in our study, it has been found that 11.8% cases with only gallstones took more than 90mins from insertion of trocar to extraction of gallbladder as compared with cases of gallstones with other findings, where 48% cases took more than 90mins.

In our study, 7.1% cases with only gallstones took more than 20mins for dissection of gallbladder from bed, whereas 23.3% cases of gallstones with other findings took more than 20mins.

In our study, the complications which led to difficult laparoscopic cholecystectomy are found to be dense adhesions at calots triangle or surrounding structures (56%), anomaly of gallbladder (4.8%), tear of cystic artery during dissection (24.4%) , empyema of gallbladder (7.3%) and sessile gallbladder (7.3%).

On the basis of preoperative ultrasonographic evaluation, surgeons should be aware of the potential problems during laparoscopic cholecystectomy and maintain a reasonable threshold of conversion if technical problems arise. This study also confirms the significant association between preoperative US evaluation and the risk of difficult surgery and other difficulties. The data from this study demonstrates that preoperative ultrasound examination of the gallbladder, the presence of gallstones, and a gallbladder wall which is 4mm or thicker in diameter alerts the surgeon of the possibility of a technically difficult laparoscopic cholecystectomy procedure due to the severity of the inflammatory response.

SUMMARY

Cholelithiasis is the most common biliary pathology. Gallstones are present in 10% to 15% of general population and asymptomatic in majority of them, of about >80%. Approximately 1% to 2% of asymptomatic patients will develop symptoms requiring cholecystectomy every year, making it one of the most common operations performed.

In 1992, National Institute of Health consensus development conference stated that laparoscopic cholecystectomy provides a safe and effective treatment for most patients with symptomatic gallstones.

In about 5% to 10% cases of laparoscopic cholecystectomy, conversion to open cholecystectomy may be needed for safe removal of gallbladder. Therefore it is necessary to predict such difficult laparoscopic cholecystectomy with pre-operative ultrasonographic criteria.

This study was conducted in the department of surgery, Regional Institute of Medical Sciences, Imphal. This study was carried out on 200 patients over a period of 3years. Out of these 200 patients, majority undergone easy laparoscopic cholecystectomy. We found that the highest incidence of gallstones is in the age group of 31 to 40 years, with female preponderance.

Ultrasonographic findings of gallbladder wall thickness more than 4mm, stone impacted at the neck of gallbladder, contracted gallbladder, common bile duct diameter more than 6mm are found to be significant predictors of difficult laparoscopic cholecystectomy in our study.

In this study, majority of the cases undergoing difficult laparoscopic cholecystectomy could be successfully predicted pre-operatively with ultrasonographic findings of thickened gall bladder wall, stone impacted at the neck, contracted gallbladder, & dilated common bile duct. This is evidenced by the fact that the time taken from insertion of veeres needle to the extraction of gallbladder was more in cases with ultrasonographic findings of gallstones associated with other findings than the cases with ultrasonographic findings of gallstones only.

Adhesions around the calots triangle was the most common complication which led to difficult laparoscopic cholecystectomy. In 10 cases, there were tear of cystic artery which couldnot be predicted by preoperative ultrasonographic findings. It was due to technical issues that the cystic artery got torn accidentally. Post operatively, 8 patients developed surgical site infections and in all the cases there was biliary spillage. Post operative follow up was done for 6months and no significant complications were noted.

PLATE I

Pic. 1: Trasonographic imaging of GB showing a thickened GB wall along with a hyperechoeic lesion casting posterior acoustic shadowing (? Calculus)

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Pic. 2: USG finding of thickened gall bladder wall thickness

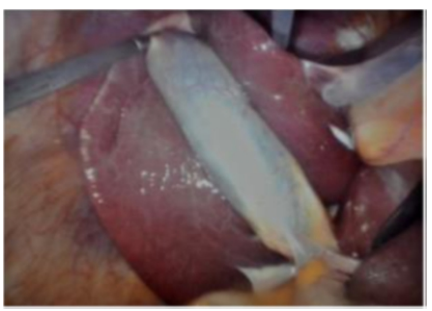
PLATE 2

Pic.3: Transverse sonogram of gallbladder region reveals thickened (4.8 mm) gallbladder wall (arrow).

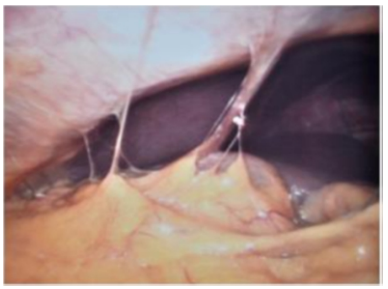
Pic.4: Longitudinal section reveals hydropic gallbladder (length, 9.4 cm; diameter,

5.1 cm). Thickening is most pronounced and focal at fundus (arrow), consistent with advanced inflammatory change.

PLATE 3



Pic.4: Intraoperative image demonstrating < 50% of gallbladder covered by adhesions.



Pic.: Intraoperative image demonstrating gallbladder completely buried in adhesions.

PLATE 4

Pic.5: Clipped cystic duct and artery

Pic.6: Laparoscopic hand instruments.

PLATE 5

Pic. 7: High definition LCD laparoscopic monitor.

PLATE 6

Pic.8: SonoAce X 8 ultrasound system.

PLATE 7

Pic. 9: Showing laparoscopic procedures.

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