"Gall Bladder Wall Thickness At Preoperative Sonography And Its Impact On Operative Outcome Of Laparoscopic Cholecystectomy: A One Year Prospective Study At KAHER'S Dr. Prabhakar Kore Hospital And MRC."

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ACCEPTANCE LETTER

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LIST OF ABBREVIATIONS USED

MIS	-	minimally invasive surgery
SAGES	-	Society of American Gastrointestinal and Endoscopic Surgeons
CBD	-	Common bile duct
EUS	-	Endoscopic ultrasound
MRI	-	Magnetic resonance imaging
CT	-	Computed tomography
MRCP	-	MR cholangiopancreatography
US	-	Ultrasonography
ERCP	-	Endoscopic Retrograde Cholangiopancreatography
NSAIDS	-	nonsteroidal anti-inflammatory drugs
ESL	-	Extracorporeal shock wave lithotripsy
OC	-	open cholecystectomy
LC	-	Laparoscopic cholecystectomy
GB	-	Gallbladder
VAS	-	Visual analog scale
mm	-	millimetre
HPR	-	Histopathological report
IP NO	-	Inpatient Number

ABSTRACT

Gall Bladder Wall Thickness At Preoperative Sonography And Its Impact On Operative Outcome Of Laparoscopic Cholecystectomy: A One Year Prospective Study At Kaher's Dr Prabhakar Kore Hospital And MRC.

Background:

Ultrasonography is quite useful in determining the appearance of the gallbladder. The purpose of this study was to examine the significance of ultrasonography in predicting difficult laparoscopic cholecystectomy and to correlate preoperative factors with laparoscopic cholecystectomy intraoperative findings.

Methodology:

From January 2020 to February 2021, this hospital-based prospective study was undertaken in the Department of General Surgery, KLES Dr. Prabhakar Kore Hospital and Medical Research Centre, Belagavi. A total of 50 individuals with right hypochondriac pain who were diagnosed with cholelithiasis and had their cholecystectomy laparoscopically were investigated.

Results:

The male female ratio was 1:2.1 and 83% of the patients were females. The age group most affected was 51-60 years. The most prominent complaint was pain in abdomen. Ultrasound findings showed 54% of the patients with multiple numbers of stones, 36% with stone size of ≥10 mm and 50% had gallbladder thickness of ≥4 mm. Intra operative findings revealed significant correlation between bleeding (r= 0.688) in patients with thickened gallbladder wall, difficult Calot's triangle dissection (r= 0.744) and difficult gall bladder extraction (r= 0.834). Also significant correlation

was noted with intraoperative time(r=1) and postoperative pain(r=0.832) with patients having thickened gallbladder wall.

Conclusion and interpretation:

Hence, it may be concluded that, ultrasonographic finding like gall bladder thickness of ≥ 4 mm help in predicting difficult laparoscopy.

Keywords:

Cholelithiasis; Difficult laparoscopic cholecystectomy; Laparoscopic cholecystectomy; Open cholecystectomy

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INTRODUCTION

Gallstones occur within the gallbladder as result of metabolic degradation of bile [1]. Gallstones occur due to an imbalance between components of bile and cause precipitation of one or more of the individual components. Cholelithiasis constitutes to global health problem burden significantly. About 20 million people in the USA, which is about 15% of the population is estimated to have gallstones [2].The median prevalence of cholelithiasis in large population surveys in Europe ranges from 5.9% to 21.9% [3]. In Australia the prevalence rate varies from 15% to 25%[4]. In India the prevalence of gallstones is estimated to be around 4%[5]. Increasing prevalence is a reflection of the increasing life expectancy and changes in lifestyle in Westernized societies [6].

Cholelithiasis is one of the major surgical issues in several hospital admissions and surgical interventions. Cholelithiasis has been associated to obesity, metabolic disorder and dietary habits. Gallstones are more common in older individuals than younger individuals. In 10-25% of people, rapid weight loss has been attributed to the occurrence of sludge and/or gallstones within few weeks of starting the slimming procedures [7]. In the presence of diabetic neuropathy, gallbladder function is impaired and regulation of hyperglycaemia with insulin seems to boost the lithogenic index[8].

Treatment of gallstones depends partially on whether they are causing symptoms or not. Recurrent episodes of upper abdominal pain associated with gallstones becomes a major indication for the treatment of gallstones.

On March 17, 1987, Philippe Mouret[9] undertook the first laparoscopic cholecystectomy. Laparoscopic cholecystectomy was fully incorporated into general surgery, surprisingly, within 2 years to 3 years, and reports of the successful use of laparoscopy in larger clinical studies have facilitated development of minimally

invasive surgery (MIS) on a rapid scale. Laparoscopic cholecystectomy has been incorporated worldwide mostly because postoperative pain is less, hospital stays are shorter, recovery is speedy hence return to work is quicker and cosmetic results are better than with the open procedure. Traditionally believed absolute contraindications for laparoscopic cholecystectomy in certain specific situations have in majority been resolved and considered relative [10].

A cholecystectomy which has an increased surgical risk compared with standard cholecystectomy can be termed as "difficult cholecystectomy" [11,12]. Intra operative difficulty of cholecystectomy can be attributed to processes that either obscure normal biliary anatomy (e.g. acute or chronic inflammations) or operative exposure (e.g. obesity or prior upper abdominal surgery). The SAGES Safe cholecystectomy program has identified six steps that surgeons can undertake to enhance the universal culture of safety around cholecystectomy. Understand and apply the critical view of safety. Recognise and understand the potential for aberrant anatomy. Make liberal use of cholangiography or other means of imaging the biliary tree, which may be especially important in managing the difficult gallbladder. Consider an intra operative timeout before clipping or cutting any ductal structures. Recognise when the dissection is approaching an area of significant risk (e.g. severe inflammation in the hepatocystic triangle or porta hepatis) and halt the dissection before entering that zone. In such cases, one should consider altering to subtotal cholecystectomy or other approaches. Get help for difficult cases or if there is a suspicion of possible biliary or other injury [13].

Direct observation with structured criteria for performance may be considered as the most trustworthy and effective method of assessing technical skill during any operative procedures. Winckel [14] and colleagues have demonstrated that the usage of

a checklist while observing open procedures proved to be a trustworthy and valid tool for assessing technical skills. This same group later concluded that a global assessment of performance as opposed to a structured checklist demonstrated better correlation among observers when compared to technical skill measurement.

A preoperative scoring system based on history, clinical examination and sonological findings can be used to predict the intra operative difficulties. There is a requirement for studies to validate a scoring system based on the Indian population and Indian hospital system. Studies [15,16,17] have been undertaken to study the individual risk factors in predicting operative difficulty. Many of these studies have identified gallbladder wall thickness as an independent risk factor [18,19,20]. In spite of this most of these studies consider thickness of gall bladder as thick or not thick while considering its impact on surgical outcomes. Degree of gall bladder wall thickness has not been assessed by studies adequately. Identification of the predictive factors for complications and conversion is very important as it would greatly benefit surgeon's preparedness as well as the patient's expectations.

OBJECTIVES

The following were objectives of this study

- To assess the role of preoperative ultrasonography in predicting difficulty of laparoscopic cholecystectomy
- To determine correlation of preoperative gallbladder wall thickness and intraoperative and postoperative findings of laparoscopic cholecystectomy

REVIEW OF LITERATURE

Anatomy of gallbladder:

The gallbladder acts as a reservoir which is located in the cystic fossa present on the undersurface of the right lobe of the liver [21]. It can be delineated from the hepatic parenchyma by presence of cystic plate, which is made up of connective tissue that extends to the left side as the hilar plate. Essentially gallbladder can be described in following parts as fundus, body and neck. The fundus of gallbladder often lies over free edge of the liver and is in close proximity to the cystic plate. The angle made by the neck of the gallbladder with the fundus creates Hartmann's pouch[21].

Embryologically from the ventral wall of the duodenum, a diverticulum is produced which differentiates to form the hepatic ducts and the liver [22]. The gall bladder and cystic duct are derived from a diverticulum that arises from the side of the hepatic bud. The arterial supply to gallbladder is derived from cystic artery which is the branch of right hepatic artery. This artery traverses through the Calot's triangle, which is made by the lower border of liver superiorly, cystic duct laterally and common hepatic duct medially [21]. This surgical anatomy is of significance during cholecystectomy as the cystic artery and occasionally bile duct may pass through this triangle and are at risk of injury during surgery [23]. The venous supply of gallbladder is different from other organs in that multiple smaller veins pass into tributaries of the right portal vein within the liver, straight from the gall bladder through its bed. The lymphatic drainage of the gallbladder is into the cystic lymph node of Lund which lies in the fork created by the junction of the cystic and common hepatic ducts. From here the efferent vessels drain into the liver at its hilum and subsequently into the coeliac

lymph nodes. The subserosal lymphatic channels of the gallbladder merge with the subcapsular lymph channels of the liver.

The musculature is present in gall bladder wall and within sphincter of Oddi though scanty muscle fibres are dispersed throughout the remaining bile duct system [23]. The lining mucosa consists of columnar cells containing mucus-secreting glands. The crypts of Luschka are formed by indentations in the mucous membrane that dip into the muscle coat. The cystic duct is about 3cm long but the length is often variable. The lumen may range from 1–3mm in diameter. The cystic duct mucosa has spiral folds which are named as the valves of Heister and the sphincter of Lütkens surrounds the wall of cystic duct.

The bile duct is approximately 6 mm in diameter and can be divided into two parts: the upper part called the common hepatic duct is situated above the cystic duct, which joins it to form the lower part, the CBD. The common hepatic duct is created by the merging of the right and left hepatic ducts and is usually less than 2.5 cm long. The cystic and common hepatic ducts join to produce the CBD, which is roughly 7.5 cm long. The CBD can be broken down into four sections [Fig. 1]:

- Supraduodenal portion which runs along the free edge of the lesser omentum and is about 2.5cm in length
- Retro duodenal portion
- Infraduodenal portion which rests in a groove present over posterior aspect of the pancreas but may lie in the tunnel.
- The intraduodenal portion is one which passes obliquely through the wall of the second part of the duodenum, at this point it is surrounded by the sphincter of Oddi and it terminates by opening on the summit of the ampulla of Vater[21]

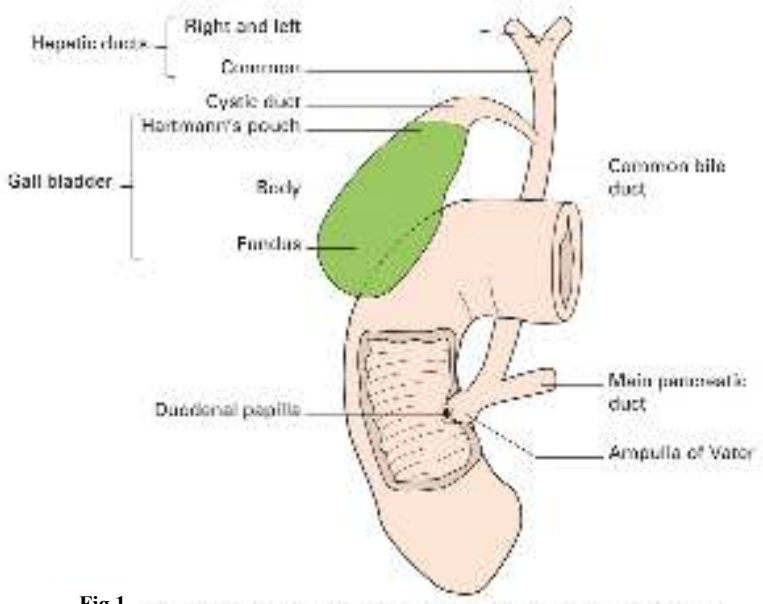


Fig 1. The gall bladder and its duct system. (The anterior wall of the second part of the duodenum has been removed.)

Anomalies in the development of gall bladder and biliary system are important to be considered as not accounting for these can cause grave outcomes during cholecystectomy. Following images discuss the main variations of gall bladder and cystic duct anomalies and cystic artery variations [24] [Fig. 2 and Fig. 3].

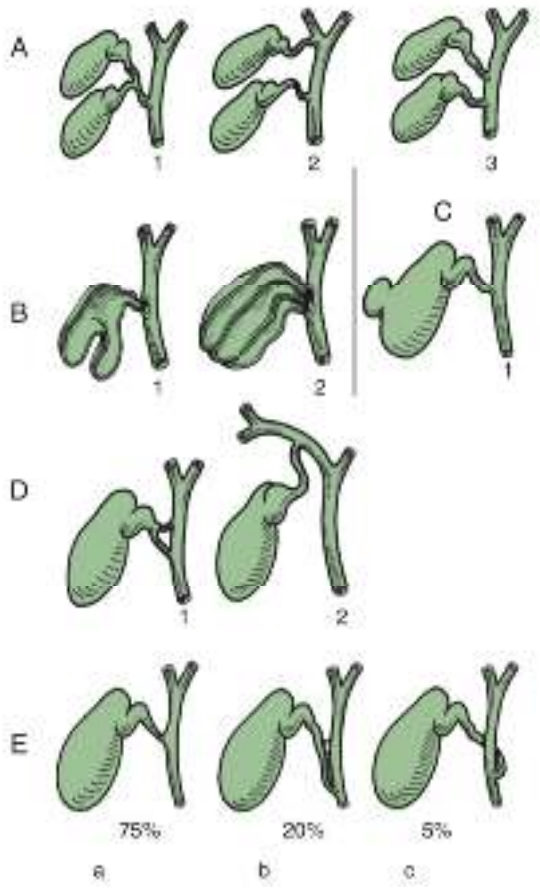
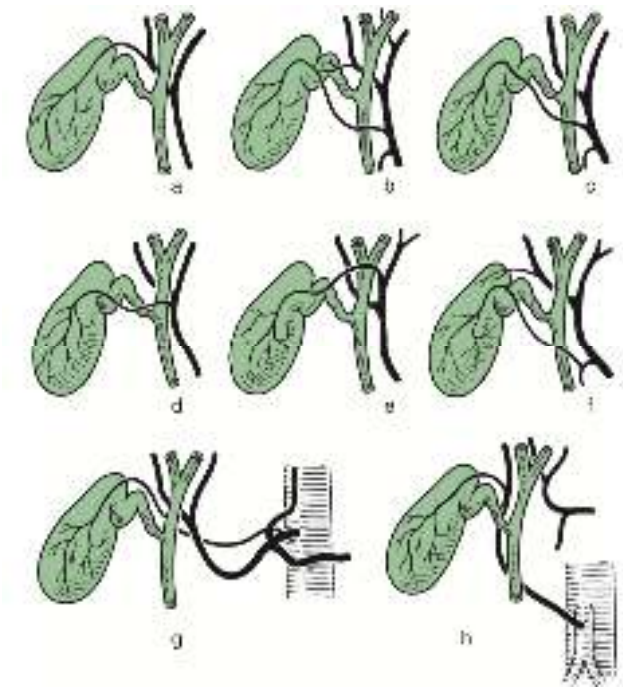


Fig 2. Variations in gall bladder anatomy

Fig 2. Variations in gall bladder anatomy. A, Duplicated gallbladder. B, Septum of the gallbladder. C, Diverticulum of the gallbladder. D, Variations in cystic ductal anatomy. E, Different types of union of the cystic duct and common hepatic duct: angular union (a), parallel union (b), spiral union (c).



The main variations of the cystic artery: typical course *(a)*, double cystic artery *(b)*, cystic artery crossing anterior to main bile duct *(c)*, cystic artery originating from the right branch of the hepatic artery and crossing the common hepatic duct anteriorly *(d)*, cystic artery originating from the left branch of the hepatic artery *(e)*, cystic artery originating from the gastroduodenal artery *(f)*, cystic artery arising from the celiac axis *(g)*, cystic artery originating from a replaced right hepatic artery *(h)*.

Fig 3. Cystic artery anomalies

Laparoscopic anatomy in cholecystectomy:

With increasing popularity of laparoscopic cholecystectomy, anatomy of the biliary system and the Calot's triangle has been associated with the new insights and the term laparoscopic anatomy has been coined. The different anatomical 'laparoscopic view 'of the area around the gallbladder especially the Calot's triangle plays a role in misidentification of structures. Often wrong method of retraction can result in distortion of Calot's triangle by flattening it rather than opening it out[25]. This in turn may lead to bile duct injuries. To minimise the risk of bile duct injury; various operative dissection techniques have been utilised, among this the "Critical view" is most reliable. Strasberg et al [26] described this technique of Critical view [Fig. 4] which includes the dissection with freeing of all tissue at the triangle of Calot except the cystic duct and cystic artery with the base of liver bed being exposed. The dissection is such that only two structures are seen entering the gallbladder which can only be the cystic duct and artery. This technique doesn't require exposure of the common bile duct.

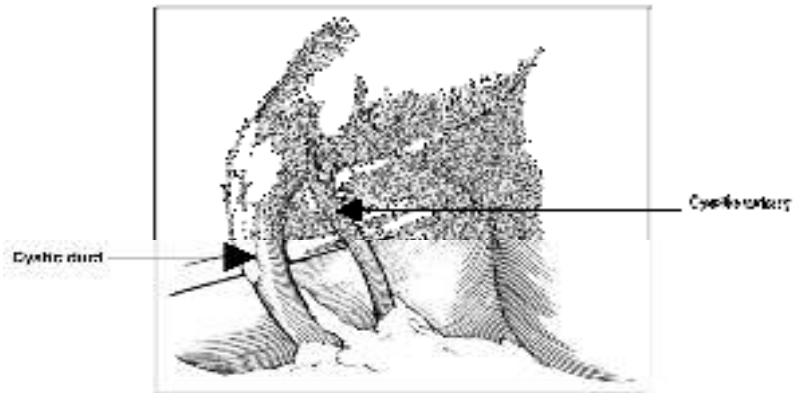


Fig 4. Strasberg's "critical view." The triangle of Calot is dissected free of all tissue except for cystic duct and artery, and the base of the liver bed is exposed.

Physiology of Gall bladder:

Bile which is prepared by the liver is stored in the gallbladder and discharged into the duodenum at intervals. Water (97%), bile salts like cholic and chenodeoxycholic acids, deoxycholic and lithocholic acids, cholesterol bilirubin and phospholipids constitute the bile which leaves the liver [27]. Bile is secreted at an estimated rate of approximately 40mL per hour by the liver. Of this majority (95%) bile salts are reabsorbed through the enterohepatic circulation that takes place in the terminal ileum.

The gallbladder serves as a bile storage area. During fasting, the sphincter of Oddi is more resistant to flow, and bile released by the liver is redirected to the gallbladder. Following food intake, the sphincter's resistance to flow is lessened, the gallbladder contracts, and the stored bile enters the duodenum. The hormone cholecystokinin acts to produce these motor responses of the biliary tract [27].

The active absorption of water, sodium chloride, and bicarbonate by the gallbladder's mucous membrane is responsible for bile concentration. The concentration of bile salts, bile pigments, cholesterol, and calcium in hepatic bile that enters the gallbladder increases 5–10 times, with a corresponding increase in the proportion of bile salts, bile pigments, cholesterol, and calcium. Gallbladder also secretes mucus of approximately 20 mL per day [27].

Risk factors of Cholelithiasis:

Important risk factors have been associated with gallstone disease. Several studies comparing people with gallstones to those without, have shown that gallstone development is complex. These risk factors can be broadly divided as modifiable and non-modifiable. Factors such as ethnicity, advancing age, female gender and genetics

fall within the non-modifiable category. The modifiable risk factors are described below:

Obesity

Hypersecretion of cholesterol has been implicated as a chief pathogenic factor among obese patients. The local distribution of fat has been associated to gallstone disease. High central adiposity has been linked to a higher risk of gallstone disease.

Estrogen and cholesterol lowering agents

Elevated estrogen levels in patients with pregnancy, those receiving hormone replacement therapy and those on oral contraceptives pills are associated with raised cholesterol levels in bile and reduced gallbladder motility, both can be attributed to cause gallstones.

Diabetes mellitus

Contraction of gallbladder is poor among diabetic patients, especially in patients with autonomic neuropathy as compared to that of healthy subjects which is referred to as the diabetic neurogenic bladder. This is often thought to be responsible factor for increased prevalence of cholelithiasis and its complications in diabetic patients.

Fasting

As discussed earlier gallbladder motility is reduced during fasting which can lead to bile over concentration with cholesterol, which can result in gallstones formation.

Rapid weight loss

Among individuals undergoing speedy weight loss by using low caloric diets gallstone disease is often encountered. During weight loss the cholesterol in the adipose tissue is activated and is secreted into bile. This leads to supersaturation of

cholesterol in bile and also results in reduced gallbladder contraction which in turn results in cholelithiasis.

Gallstone Disease burden:

Gallstones are a major health issue in both advanced and emerging economies, affecting 10% to 15% of the adult population, or 20 to 25 million Americans who are presently affected (or will develop) gallstones. [2,28-30]. Gallbladder disease in US has been attributed to annual consumption of ~$6.2 billion in manner of direct and indirect cost associated with the disease which constitutes a major health burden [2,31,32]. Over the last 3 decades it has increased more than 20%. According to population-based prospective research, Americans and Pima Indians with cholelithiasis have a higher overall mortality rate, especially from cardiovascular disease and cancer.

In a survey conducted by Framingham study group [33], diagnosed cases of gallstones among a random sample of predominantly Caucasians aged 30-62 years were recorded over a 10-year period. No cases of silent gallstones were included. This can underestimate the burden of gallstone disease by not accounting for asymptomatic gallstone disease. Studies [3,34] in Western Europe show that the prevalence ranges from 5.9% to 21.9% Prevalence rates of 3.2% to 15.6% have been reported amongst Asian population [2].

In adult population in India the prevalence was noted to be 6.12% [5]. It was found that cholelithiasis is more common among females than males. There was a significantly higher prevalence was noted amongst the Northern Indian population compared to the Southern Indian population. This was attributed to difference in ethnic background. Southern Indian population showed a predominance of pigment

gallstones in contrast to North Indians who showed a predominance of cholesterol gall stones [35-37].

Despite the increased prevalence of cholelithiasis, many individuals are asymptomatic and may not require therapy or follow-up. Over the course of 10–15 years of follow-up, about 10%–15% of people with gallstones become symptomatic [38]. Symptomatic gallstones can appear in a variety of ways, ranging from mild symptoms like biliary colic to severe presentations like pancreatitis, which can cause major morbidity and mortality. A patient who has had symptomatic gallstones is at risk of further manifestation during the course of their life, with an annual incidence of about 3%.[39].

Gallstones mainly consists of cholesterol, bilirubin, and calcium salts, with smaller proportion of protein and other materials [40,41]. Gallstone are of following 3 categories: (a) Pure cholesterol stones containing 90% cholesterol, (b) pigment stones which may be brown or black containing at least 90% bilirubin and (c) mixed composition stones which are made up of different proportion of cholesterol, bilirubin and other substances like calcium carbonate, calcium phosphate and calcium palmitate.

Investigations :

Laboratory investigations:

In complicated gallstone disease the liver function tests will show abnormalities. There may be leukocytosis with a "left" shift in acute cholecystitis. Gallstones cause acute pancreatitis, which is accompanied by amylase and lipase increases. Hepatic transaminases and alkaline phosphatase levels will be elevated if gallstones plug the common bile duct.

Imaging:

Imaging of the gallbladder is important in the assessment of patients who come with abdominal discomfort, particularly pain in the right upper quadrant.

Gallbladder sonography has become the standard method for gallbladder examination. Its accuracy for detecting gallbladder stones is in excess of 95% [42]. This has occurred in part because sonography is a convenient and safe initial examination and in part because sonography can be easily extended to include the biliary ducts and the adjacent organs of the upper abdomen. Because the presence of gallstones is usually the most convincing evidence for performing cholecystectomy, the direct demonstration of calculi by sonography in part explains its common use as the initial examination.

Commented [1]:

Gallstone are seen as highly reflective echogenic foci with posterior acoustic shadowing [Fig.5]. If they contain nitrogen gas within fissures, they may exhibit "dirty" shadowing and reverberation artefact. Gallstones are movable and shift location when the patient is scanned in supine and decubitus positions, resulting in the rolling stone sign [43]. The sonographic Murphy's sign is present in acute cholecystitis. When the sonographer puts the ultrasound probe over the fundus of the enlarged gallbladder, the patient experiences the most pain [44].

Fig 5 Sagittal ultrasound image of the gallbladder which demonstrates the typical appearance of a gallstone that is hyperechoic with posterior acoustic shadowing (arrow)

Gallbladder wall thickening can be caused by inflammatory, benign, and malignant etiologies. Pseudothickening caused by the normal postprandial state of the contracted gallbladder is also extremely common. A thickened gallbladder wall measures more than 3 mm, typically has a layered appearance at sonography[Fig. 6].

Fig 6 Sagittal ultrasound image of the gallbladder which contains hyperechoic gallstones. There is gallbladder wall thickening (black arrow) and pericholecystic fluid (white arrow) consistent with acute calculous cholecystitis

In patients with cholecystolithiasis who present with biliary pain and a normal abdominal ultrasound, EUS has a high sensitivity of 94–98% [45].

MRI is a recommended imaging modality when ultrasound findings are inconclusive [46] [Fig.7]. CT is less sensitive for diagnosis of gallbladder stones. The gallbladder and biliary tract are precisely morphologic and functionally assessed by MR cholangiopancreatography. With non-conclusive US findings, MR imaging is used to evaluate suspected choledocholithiasis, suspected Mirizzi syndrome, and suspected acute cholecystitis, as well as to differentiate gallbladder malignancy from benign entities.

Endoscopic Retrograde Cholangiopancreatography (ERCP):

Because it is also useful for removing bile duct stones, ERCP has become the gold standard treatment for detecting gallstones in the common bile duct [47]. The bile and pancreatic ducts are visualised using an endoscopic approach. The assessing physician inserts a side-viewing endoscope, also known as a duodenoscope, into the duodenum, facing the major papilla. This duodenoscope is designed to make inserting

endoscopic equipment into the bile duct and pancreatic duct as simple as possible. These devices are inserted into the bile duct and pancreatic duct through the biopsy channel. A device like catheter is used to introduce dye into the pancreatic and biliary ducts, and fluoroscopy is used to produce x-ray images. The clinician can see two sets of images during this procedure: an endoscopic view of the duodenum and major papilla, and a fluoroscopic image of the biliary and pancreatic ducts.

Complications of cholelithiasis:

Pancreatitis

Bile duct stones

Acute cholecystitis

Gallbladder empyema, necrosis

Gallbladder cancer

Cholecystoenteric fistula

MEDICAL THERAPY OF GALLSTONES:

Pain control:-

In patients with acute biliary colic the treatment is aimed primarily at pain control with nonsteroidal anti-inflammatory drugs (NSAIDs) or narcotic pain relievers. NSAIDs are preferred drugs for most patients as they are similar in efficacy with lesser adverse effects. Another choice for pain control is use of antispasmodic agents (e.g., scopolamine), which relax and relieve the spasms of the gallbladder.

Oral dissolution therapy:-

Oral bile acids, bile acids used as adjuncts to lithotripsy, and contact dissolution using methyltertbutylether are the three types of medical treatment now in use. The method utilised is primarily determined by the size of the gallstone. Oral bile acids such as chenodeoxycholic acid 15mg per kg per day or ursodeoxycholic acid 10mg per kg per day, administered alone or in combination, are the best treatments for gallstones less than 6mm in diameter. Single stones with a diameter of less than 30mm or numerous stones (n = less than 3) can be managed with lithotripsy using bile acids for fragment dissolution. Using direct contact dissolution with methyltertbutylether is possible for any size and number of stones. The major disadvantage for dissolution therapy is that in about 50% of patients recurrence is seen which cannot be managed using low dose bile acids or any dietary changes [48-50].

Extracorporeal Shockwave Lithotripsy:

Extracorporeal shock wave lithotripsy is an effective noninvasive therapeutic alternative among symptomatic patients [51]. The incidence of adverse effects like biliary pancreatitis, liver hematoma are rare but the limitations of the procedure include stone recurrence. It is important to note that complete ductal clearance is not always achieved as the size or position of the stones varies.

SURGICAL TREATMENT OF CHOLELITHIASIS:

Evolution of cholecystectomy throughout history:

The first surgical intervention for gallstones was in 1687, when Stal Pert Von Der Wiel[52] unintentionally discovered gallstones while operating on a patient with purulent peritonitis. Till the advent of 18th century, the treatment for gallstones

disease was primitive and not very effective. Jean Louis [53] is credited with successful creation of fistula in patients with empyema of gallbladder in 1743. He has been regarded as the founder of gallbladder surgery. Over the years modification were made to Petit's technique. This involved from use of skin stimulants, which would result in creation of adhesion between gallbladder and abdominal wall and use of indwelling trocars which would help in removal of stones and bile from this adhered gallbladder thereby minimising peritonitis.

Though modifications were made, this remained the technique of choice until 1859 at which time J. L. W Thudichum [54] proposed a two-stage procedure for elective cholecystostomy. The first stage of which included sewing of the inflamed gallbladder to abdominal wall anteriorly through a small incision. This incision was used as a route for gallstone retrieval at later date as a second stage procedure. Dr John Stough Bobbs [55], on July 15 1867, while performing operation on a suspected ovarian cyst patient incidentally came across an inflamed and adhered sac, the presence of solid conventional rifle bullet-like formations was noticed. He opened the sac and found that it contained gallstones. These were then removed and the sac was closed leaving the gallbladder in abdomen. Thus, he performed cholecystostomy following which the patient recovered well.

In 1878 Marion Simms[56] performed the first cholecystostomy on an obstructive jaundice woman. The first successful cholecystostomy was performed by Theodor Kocher [57] in June 1878. Despite modifications this procedure remained a temporary solution and a need for definitive therapy was realised. Carl Lagenbauch[56] developed a method of cholecystectomy using cadaveric dissection. On 15th July 1882, Lagenbauch successfully performed cholecystectomy [Fig. 8] on a male of 43 years of age, suffering for 16 years from the disease. He noticed that the gallbladder

was chronically inflamed and thickened containing two stones. By the end of the century this became an established procedure for permanent pain relief in patients of gallstone disease.

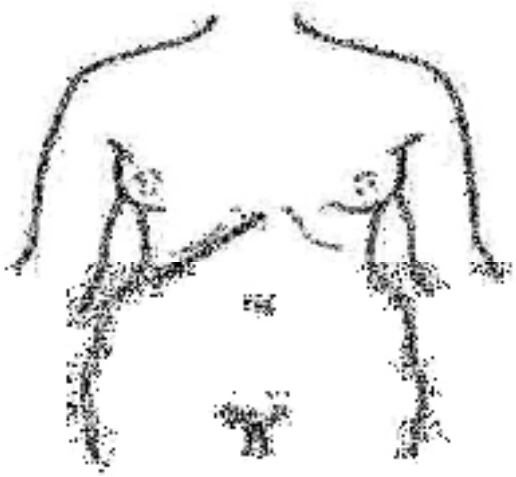


Fig 5: Kocher's incision for open cholecystectomy

With introduction of various laparoscopic techniques this procedure was further revolutionised. Though laparoscopy was considered as an important adjunct to surgical practice, it's use was restricted. The major limiting factors to use of laparoscopy were improper light sources, risks of thermal injury to intrabdominal organs, dangers of perforation of bowel and possible vascular injuries.

In the year 1929, Kalk[58], considered as the father of modern laparoscopy, suggested modification of the technique by introducing the Faroblique lens system, separate needle to create pneumoperitoneum and second puncture site. In 1938 Veress needle was developed which allowed for safe insertion and pneumoperitoneum creation due to its spring-loaded obturator. Despite these modifications and available newer techniques, the risk of intrabdominal thermal injury was a major limitation for

laparoscopic use. The field of laparoscope was revolutionised with advent of quartz rod within the telescope which transmitted intense light beam and allowed photographic images to be taken. To this a close circuit television was added in the year 1959.

Kurt Semm[59], in 1966, deviced an automatic insufflator which enabled the of monitoring intra-abdominal pressure. He was instrumental in developing the thermo coagulation, Perfecting the endoloop applicator, knot-tying procedures, and equipment, as well as a high-volume irrigation aspiration system. Despite the growing popularity of laparoscopic surgeries, general surgeons at the time thought of laparoscopy as a blind procedure and were hesitant to use it in their practices.

The first successful human laparoscopic cholecystectomy was performed by Mouret from France[60][Fig.9]. In March 1987, Mouret was performing gynecologic laparoscopy in a patient with symptomatic gallstones disease. He turned the laparoscope to visualise the sub hepatic region and finding a comparatively free gallbladder he excised it laparoscopically as compared to open procedure. The surgery was successful and patient had complete recovery without complications. This procedure started to be performed on a large scale at various centres around the world as demands increased. On September 1992, at Bethesda, a NIH consensus conference was held which deemed laparoscopic cholecystectomy as a treatment of choice for cholelithiasis[61].

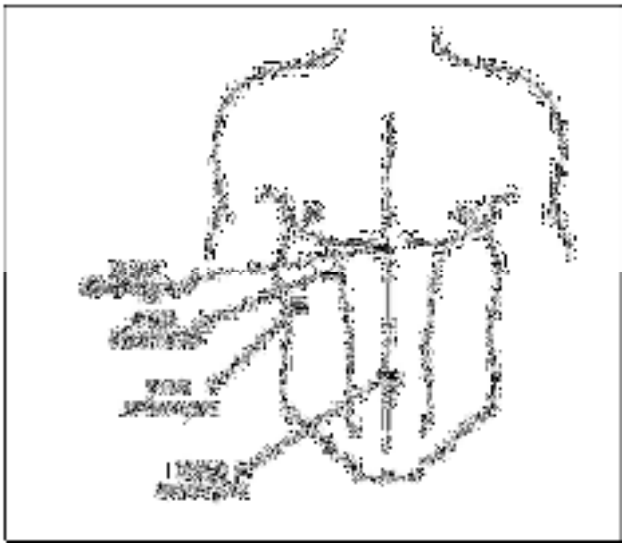


Fig 9. Placement of ports for Laparoscopic cholecystectomy

While a limited percentage of open cholecystectomy (OC) procedures are still performed as primary procedure, majority of OC procedures are now converted from laparoscopic cholecystectomy (LC). The literature reports a wide variety of conversion rates; nonetheless, in most series [62, 63], it is < 10%, and in some cases, it is as low as 1% to 2%. Conversion to open surgery is frequently described as a "complication" of LC, with individual surgeons and institutional studies praising low conversion rates. Male gender, extreme old age, obesity, previous surgery, severe disease, and emergency LC for acute cholecystitis have all been recognised as important "risk variables" that predict conversion. It's important to remember that conversion to open surgery is based on the surgeon's subjective intraoperative assessment, which weighs the severity of the inflammatory changes, the anatomy's clarity, and his or her own skill/comfort in proceeding, and should not be regarded as a laparoscopic procedure failure.

Difficult laparoscopic cholecystectomy:

With laparoscopic cholecystectomy becoming the gold standard treatment for management of cholelithiasis, studies have been conducted to predict the difficulties encountered during surgery and to understand the factors influencing the same. Studies[64-70] have demonstrated that male gender is predictor for difficult operation and conversion to open surgery.

Patients in the 31-40 age group had a considerably greater rate of difficult LC. Increased difficulty is also linked to advanced age[71-73]. LC is generally associated with a higher morbidity and conversion rate in elderly patients, despite being considered a safe therapy. Calot's triangle is difficult to recognise in the presence of pericholecystic inflammation. Biliary damage was shown to be 0.3 percent in a Swiss research[74] of over 12,000 patients, and it was linked to acute cholecystitis.

During emergency LC for acute cholecystitis, studies[75-77] found a greater conversion rate owing to the difficulty. Clinical trials reveal no significant difference in postoperative outcome among acute cholecystitis patients undergoing either LC or OC, despite contradicting results. Furthermore, Shikata et al. [78] analysed ten randomised clinical studies and concluded that LC was the best option for acute cholecystitis because there was no significant difference with respect to conversion, injuries, mean hospital stay, or mortality

Obesity is linked to a higher risk of complications, such as biliary injury. This is due to an irregular fat distribution, an enlarged liver, and access and exposure limitations. Obesity, upper abdominal surgery and acute cholecystitis form a trio that is linked to increased morbidity, operating time, and conversion rate[79].

Individuals with liver cirrhosis have a high rate of local consequences and conversion. Other studies[80,81] have reported substantial morbidity in cirrhotic

patients, and less invasive methods such as ERCP and sphincterotomy have been advised to prevent the high morbidity and mortality attributed with cholecystectomy.

Anatomical variation is a factor that predicts difficulties[82]. For a safe LC, the normal anatomy of Calot's triangle is critical. Certain disorders, such as Mirizzi syndrome, cholangiocarcinoma, and choledochal cyst, might disrupt the anatomy and pose problems.

Patients who have had prior upper abdominal surgery and have adhesions have a higher risk of surgical complications[83]. Dense adhesions make access difficult, increasing the risk of visceral damage and making dissection difficult of the cystic duct, artery, and GB.

A high conversion rate is seen in individuals with comorbidities, especially if an emergency LC was performed[84]. Grades 3 and 4 of the American Society of Anesthesiologists have been linked to difficult surgeries and poor outcomes. This could be related to a compromised cardiovascular, respiratory, or metabolic condition[85]. Early LC conducted within 72 hours for the average patient was associated with a lower conversion rate compared delayed LC, according to randomised prospective research (17 percent vs. 30 percent). Despite the fact that both therapies are safe and effective, Yadav et al[86] found that early LC has a higher conversion rate than delayed LC. A meta-analysis of 375 cases and a randomised controlled study, on the other hand, failed to find any meaningful difference in the conversion rate

The presence of stone within the cystic duct is attributed to complications during LC. A stone impacted at Hartman pouch can cause inflammatory changes which results in fibrosis leading to thickening of the GB neck as well as cystic duct.

Thus a short and wide cystic duct may remain which can be challenging as clipping may not be amenable.

Studies[87] have noted that presence of enlarged liver and a bigger gallbladder can hinder visualisation of operating field thus resulting in inadequate exposure. This delays operative progression and often a need for conversion or other option may be planned.

Cholangiocarcinoma has been linked to challenging LC. Surgical difficulty is proportional to the stage of the disease. The rate of incidental GB carcinoma has been estimated to be around 1.75 percent[88].

Adhesions, inflammation, and aberrant visceral placements are frequently associated with biliodigestive fistula[89]. These can result in injuries during surgery thereby contributing to difficult LC. The index of suspicion should be high to protect against iatrogenic injuries in these patients.

Surgeons laparoscopic experience are also linked with complications and conversion rates. A large-scale study in UK demonstrated that with increase in surgeon's caseload conversion rates reduce.

Wall thickness >3 mm has been associated with difficult LC. It is assessed using an ultrasound scan or a magnetic resonance imaging (MRI) scan. Chronic cholecystitis can make clutching and handling the GB harder, as well as dissecting and delineating the cystic duct, artery, and bile ducts. Another issue to deal with is adhesions occurring among adjacent structures such as the duodenum and the transverse colon. A study by Daradkeh[87] gallbladder wall thickness was noted to be a predictor of operative difficulty. In a study published by Haji et al.[90] concluded that thickened gallbladder bladder walls were responsible for longer operative time.

Prediction of difficult laparoscopic cholecystectomy using scoring systems:

The utilization of a predictive score system to assess operative difficulty identifies high-risk procedures and may help to enhance patient counselling, streamline surgical planning, recognize patients at risk of complications, and make modifications to the operating method. It can help detect individuals who are candidates for outpatient treatment and can be chosen for training of residents[91]

The majority of published scoring systems either estimate the risk of converting a laparoscopic technique to an open technique or use subjective assessments to identify high-risk individuals and create risk-assessment models. Although there is a strong link between surgeon experience and operation conversion, the rate of conversion may not accurately reflect the operating difficulties.

On contrary, operative time has been considered for a surgeon as a repeatable criterion for the level of difficulty experienced. Only one study, by Sakuramoto et al[92] used operative time as the primary end point among those that looked at operative difficulties. However, the study conducted over a 10 year period included patients which were operated on by only 2 surgeons did not use readily available data in the final score making the results difficult to be reproduced by other centers.

Male sex, any upper abdominal pain at the time of operation, history of previous upper abdominal surgery, sonographically diagnosed thick gallbladder wall, age >60 years, and preoperative diagnosis of acute cholecystitis were all examined in a study by Kama et al.[70] On multivariate analysis, these variables had a substantial impact on conversion risk. Another study by Lee et al.[93] found that age >65 years, male gender, patients with previous history of upper abdominal surgery, and a documented history of acute cholecystitis were all predictors for conversion.

The key deficiencies identified in the literature was lack of significant evidence on applicability of any one particular system to effectively predict difficultly of laparoscopic cholecystectomy. The variables proposed in each of the scoring systems showed significant overlap but were also different in different studies. The operational definition used for difficult cholecystectomy shows variations among different studies. There are limited studies which assess the use of any preoperative scoring system among on Indian population.

METHODOLOGY

Study site: This study was conducted in the Department of General Surgery at KLES Dr. Prabhakar Kore Hospital and Medical Research Centre, Jawaharlal Nehru Medical College, KAHER, Belagavi.

Study population: All eligible patients undergoing laparoscopic cholecystectomy in the department of General surgery at KLES Dr. Prabhakar Kore Hospital and Medical Research Centre, Jawaharlal Nehru Medical College, KAHER were included as the study population.

Study design: It was a prospective observational study.

Sample size:

The sample size was calculated assuming the expected proportion of difficult laparoscopic cholecystectomy in the population, based on study by Gupta et al[94] as 27.1%. Considering 13 % as absolute precision and 95% confidence level the sample size was calculated using the following formula.

$$n = \frac{Z^2 P(1-P)}{d^2}$$

n= Sample size

Z= Z statistic for level of confidence=1.96

P= Expected prevalence of proportion (If the expected prevalence is 20% the P=0.271) and

d= Precision (If the precision is 5% then d=0.13)

The sample size as per above calculation is 45. Attributing 5% to loss to follow up, the total sample size is 50.

Sampling method: All eligible subjects were included into the study by convenient sampling till sample size was reached.

Study duration: The period of data collection for the study was done from January 2020 to February 2021.

Inclusion criteria:

Adult consenting patients having USG reported gall stone disease and planned for laparoscopic cholecystectomy surgery.

Exclusion Criteria:

- Patient below 18 years of age.
- Gall stone disease with GB polyps, suspected GB cancer, choledocholithiasis
- Acute cholecystitis
- Bleeding disorders
- Patient with features of obstructive jaundice.
- Patient medically unfit for laparoscopic surgery.

Ethical considerations: The study was approved by the human ethics committee of the university. All study participants gave their informed written consent, and only those who were willing to sign the informed consent were included in the study. Before agreement was obtained, the risks and advantages of the study, as well as the voluntary nature of participation, were discussed with the participants. The study participants' privacy was protected.

Data collection tools: All the relevant parameters were recorded in a structured study proforma

Methodology: After obtaining the written informed consent all patients were evaluated by thorough clinical history and physical examination. Symptoms of pain in the abdomen, vomiting, fever were recorded. History of any previous upper abdomen surgery was considered.

All findings were documented on the study proforma. All participants underwent the following investigations:

* Complete blood count
* Mini renal profile
* Liver function test
* Viral markers
* Random blood sugar
* International normalised ratio
* Preoperatively ultrasonography was done to measure gall bladder wall thickness, number and size of stones, to look for presence of pericholecystic collection, also to look for Common Bile Duct calculi.

All findings were recorded on the predesigned study proforma.

Procedure:

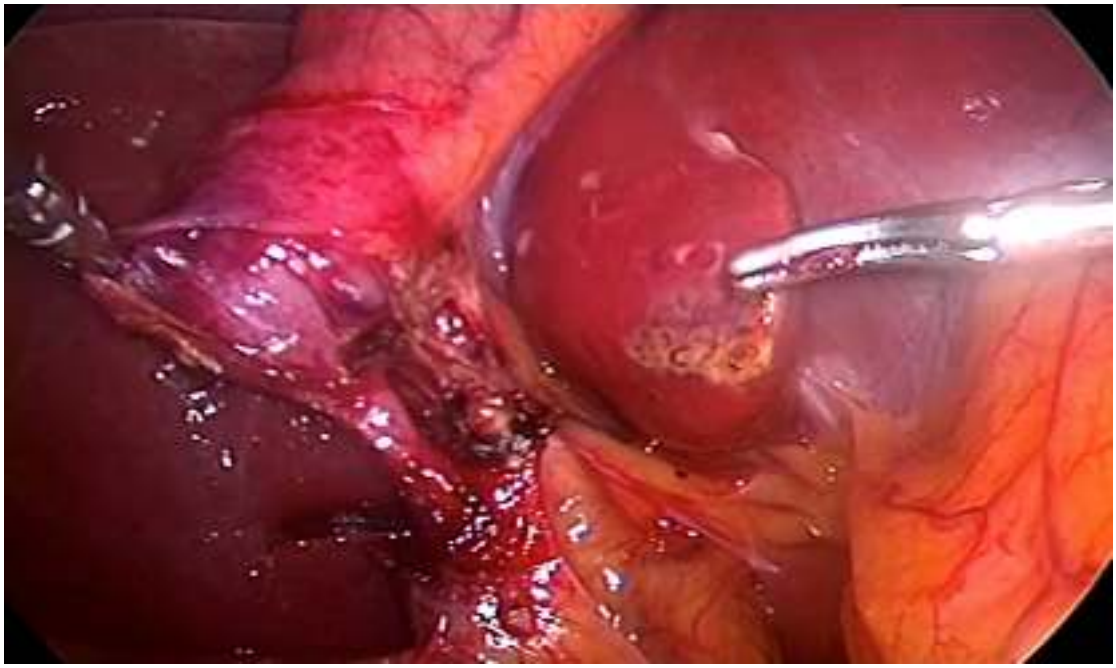
The patients having undergone complete physical examination and found fit for surgery were taken up for Laparoscopic cholecystectomy.

Laparoscopic cholecystectomy was performed in standardised manner by experienced surgeons.

Patient was placed in supine position. The surgeon stood on patient's left side with one assistant by his side holding the laparoscope and another on the opposite side. Pneumoperitoneum access was gained by either Verre's needle technique or open Hasson's method, maintaining a CO2 pressure of 15mmHg, supraumbilical incision. For Verre's needle technique in our institute double click and waterproof technique is followed to ensure correct placement. Four ports placed : optical (10 mm), one 5 mm, one 10 mm operating, and one 5.0 mm assisting port.

Photograph 1: Depicts port placement intraoperatively

Retrograde dissection was done, identifying the calot's triangle and delineating the cystic duct and cystic artery. Both structures were clearly defined and after visualising the critical view of safety, clipped and cut. Gall bladder was then dissected off the liver bed and extracted.



Photograph 2: Shows the Critical View of Safety during laparoscopic cholecystectomy.

- Time taken for surgery: Duration of insertion of Verre's needle in closed method of fist port in Open technique to time taken for port closure.
- Biliary spillage
- Incidence of bleeding
- Difficult Calot's triangle dissection
- Gallbladder bed dissection
- Anatomical variations
- Need for conversion
- Postoperative pain

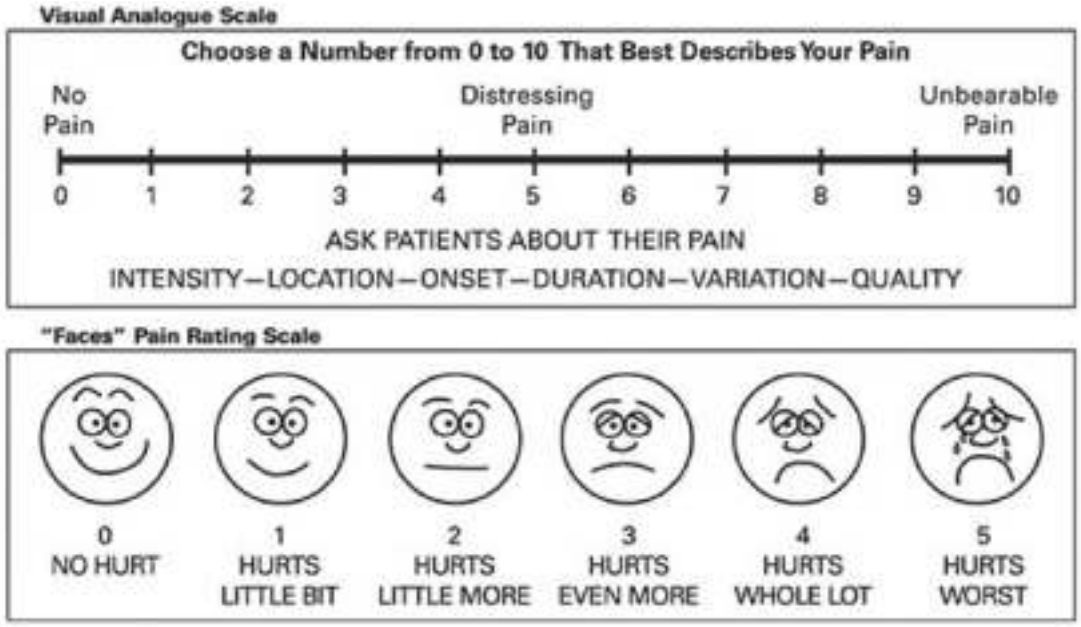


Fig 10: Shows the visual analogue scale and faces pain scale used for post-operative pain assessment

Outcome variables:

The role of ultrasonography for predicting difficult laparoscopic cholecystectomy was assessed finding relationship between ultrasonographic findings and intraoperative findings during laparoscopic cholecystectomy especially with easy and difficult laparoscopic cholecystectomy.

Statistical analysis:

The data obtained was coded and entered in Microsoft Excel Spreadsheet. The categorical data was expressed as rates, ratios and percentages. Continuous data was expressed as mean±standard deviation. The relationship between ultrasonographic findings and intraoperative findings during laparoscopic cholecystectomy was ascertained by using Pearson's correlation coefficient r, with value closer to +1 showing a strong positive correlation.

RESULTS

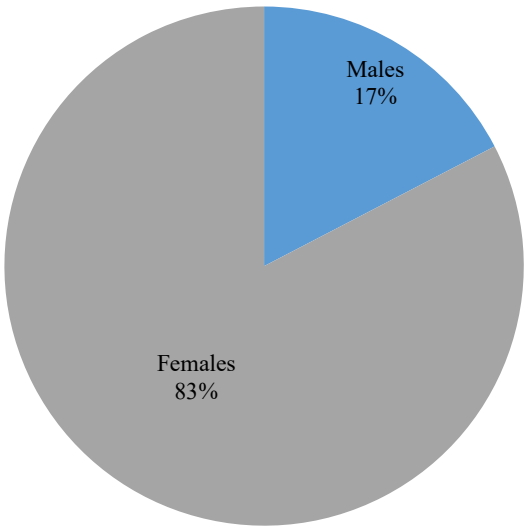
This study was conducted in the Department of General Surgery at KLES Dr. Prabhakar Kore Hospital and Medical Research Centre, Jawaharlal Nehru Medical College, KAHER, Belagavi. It was conducted in the period between January 2020 to February 2021.

A total of 50 participants with right hypochondriac pain and diagnosed to have cholelithiasis on ultrasonography were enrolled in the study with proper consent. Preoperative ultrasonography findings and intraoperative events such as bleeding, adhesions, Calot's triangle dissection, extraction of gallbladder and intraoperative time were studied. Postoperative pain was also considered.

Data collected was entered in Microsoft Excel Spreadsheet. The relationship between ultrasonographic findings and intraoperative findings during laparoscopic cholecystectomy was ascertained by using Pearson's correlation coefficient r, with value closer to +1 showing a strong positive correlation.

Table 1. Gender Distribution:

Gender	Numbers	Percentage
Males	16	17%
Females	34	83%

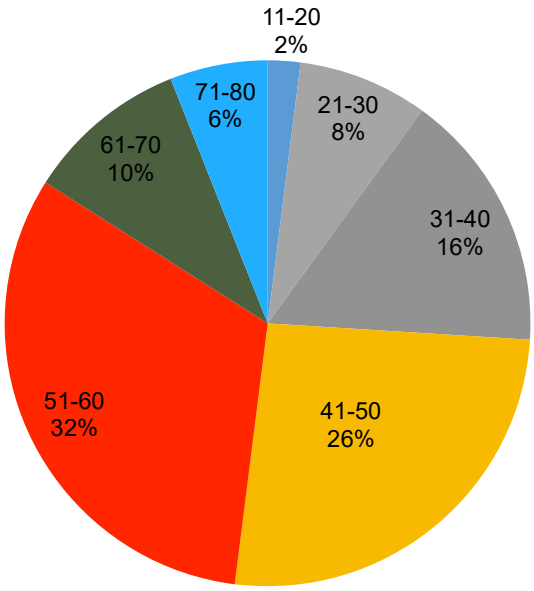


Graph 1: Pie chart showing gender distribution among study participants

Amongst the 50 participants, there were 16 males and 34 females. About 83% of patients were females and 17% were males.

Table 2. Age Group:

Age	Numbers	Percentages
11-20	1	2%
21-20	4	8%
31-40	8	16%
41-50	13	26%
51-60	16	32%
61-70	5	10%
71-80	3	6%

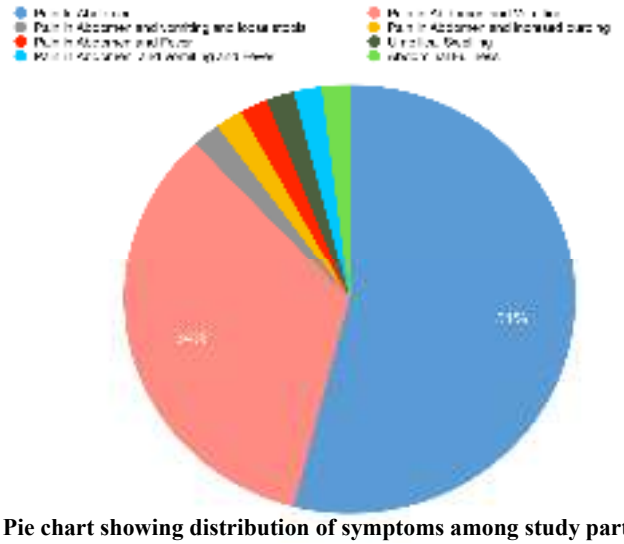


Graph 2: Pie chart showing age distribution among study participants

Majority of patients in the study were in the age group of 51-60 years followed by 41-50 years. The mean age in this study was 49.82 years. Thus ~~Thus~~ predominantly affecting 5th to 6th decade of life.

Table 3. Symptoms with which the patient came in for consultation:

Symptoms	Number	Percentages
Pain in Abdomen	27	54%
Pain in Abdomen and Vomiting	17	34%
Pain in Abdomen and Vomiting and Loose stools	1	2%
Pain in Abdomen and Fever	1	2%
Pain in Abdomen and Vomiting and Fever	1	2%
Umbilical Swelling	1	2%
Abdominal Fullness	1	2%
Pain in Abdomen and Increased Burping	1	2%

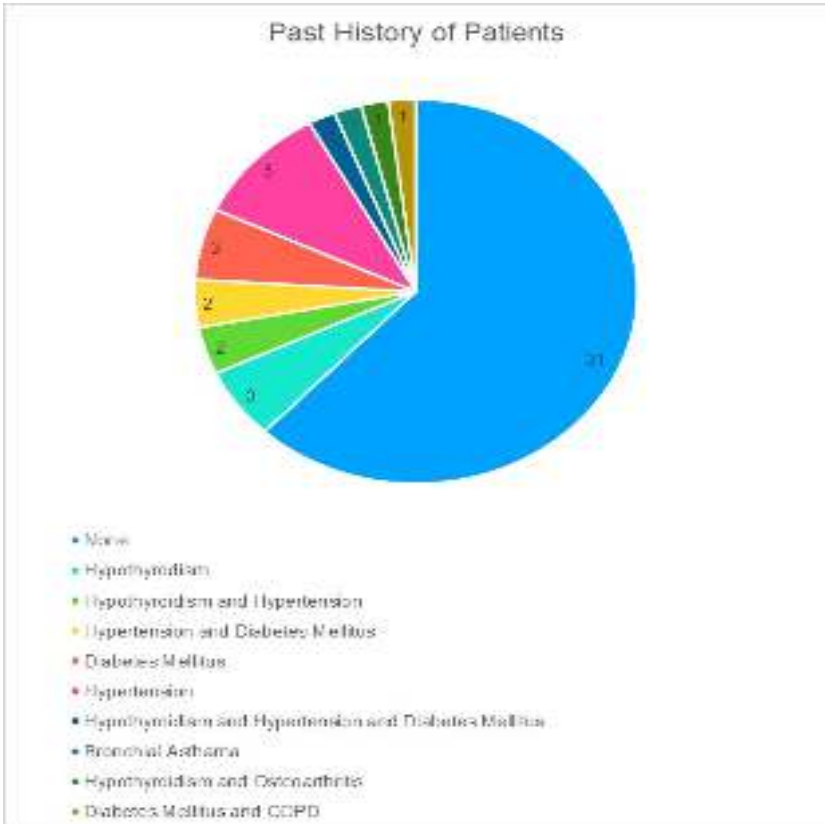


Graph 3: Pie chart showing distribution of symptoms among study participants

The patients came in with the following symptoms for consultations. The most prominent symptom in patients presenting with Cholelithiasis in our study was pain in abdomen (54%). About 34% of patients had pain abdomen associated with complaints of vomiting.

Table 4. History of comorbidities:

Past issue	Number of patients	Percentages
None	31	62%
Hypothyrodism	3	6%
Hypothyroidism and Hypertension	2	4
Hypertension and Diabetes Mellitus	2	4
Diabetes Mellitus	3	6%
Hypertension	5	10%
Hypothyroidism and Hypertension and Diabetes Mellitus	1	2%
Bronchial Asthama	1	2%
Hypothyroidism and Osteoarthritis	1	2%
Diabetes Mellitus and COPD	1	2%

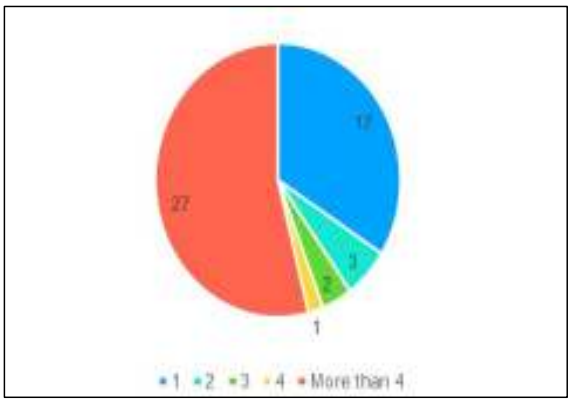


Graph 4: Pie chart demonstrating details of history of comorbidities among study participants

Majority of patients, 31 out of the 50(62%), didn't have any significant comorbidities. The most common comorbidities amongst patients ~~was~~were hypertension (10%), followed by diabetes mellitus (6%). Important to note that comorbidities can impact operative outcome of patients.

Table 5. Number of stones:

Number of Stores	Number of patients	Percentages
1	17	34%
2	3	6%
3	2	4%
4	1	2%
More than 4	27	54%
Total	50	100%

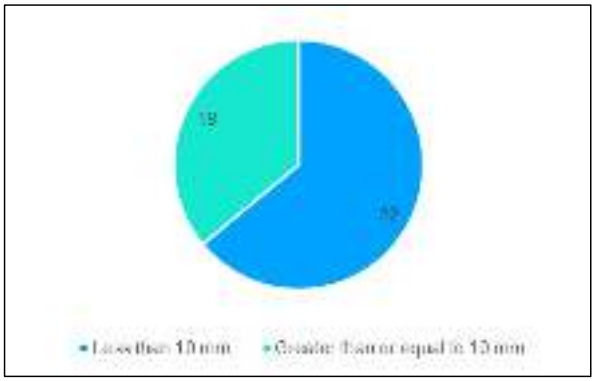


Graph 5: Pie chart showing relation of number of gallstones on ultrasonography among study participants

On ultrasonography 54% patients had more than 4 stones. About 34% patients had a solitary stone. Presence of multiple stones have been associated with increased intraoperative difficulty.

Table 6. Size of the largest stone:

Size of the largest stone	Number of patients	Percentages
Less than 10 mm	32	64%
Greater than or equal to 10 mm	18	36%
Total	50	100%

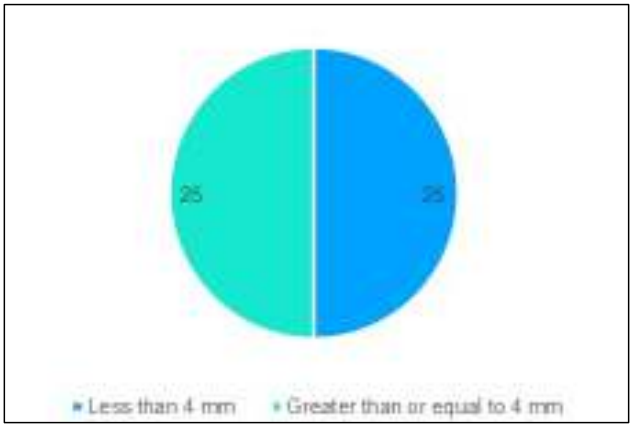


Graph 6: Pie chart demonstrating the size of stone among study participants

In sample size of 50, the above table depicts distribution of patients by size of the largest stone. Among the study participants, 64% patients had stone size of <10mm in size.

Table 7. Gallbladder Wall Thickness:

Gallbladder Wall Thickness	Number of Patients	Percentages
Less than 4 mm	25	50%
Greater than or equal to 4 mm	25	50%



Graph 7: Pie chart demonstrating the gallbladder wall thickness determined on ultrasonography and its distribution among study participants

The above table demonstrates the distribution of patients according to the gallbladder wall thickness. About 50% study patients had a gallbladder wall thickness of >4 mm on preoperative ultrasonography.

Table 8. Association between Gallbladder Wall Thickness and Bleeding:

	Total Number of patients	Patients experienced bleeding	Percentages
GB Wall thickness < 4 mm	25	5	20%
GB Wall thickness = > 4 mm	25	24	96%

r= 0.688

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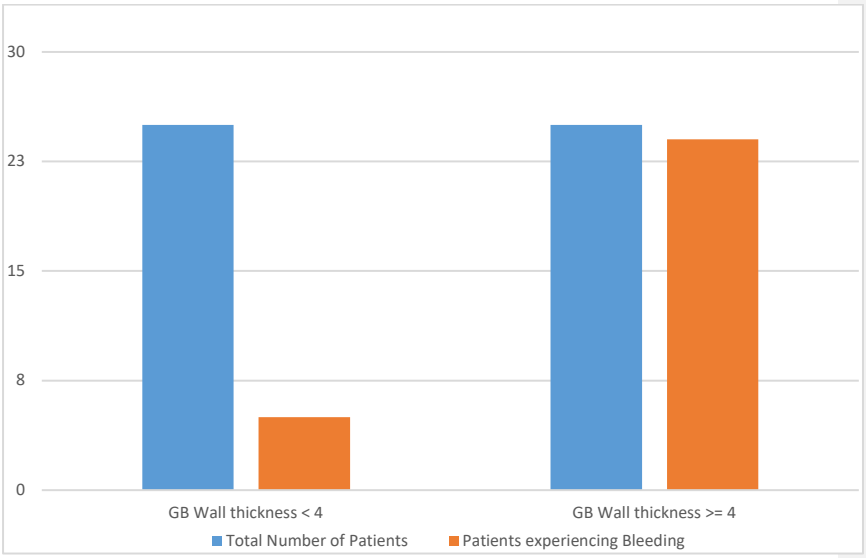
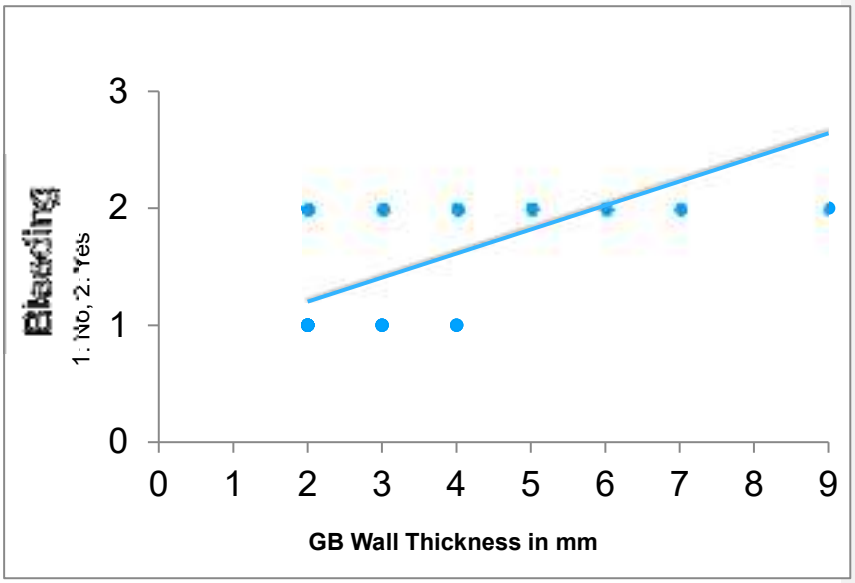


Graph 8: Bar graph showing association between Gallbladder wall thickness and intraoperative bleeding among study participants



Graph 9: Scatter plot showing correlation between Gallbladder wall thickness and intraoperative bleeding among study participants

Out of the 25 patients who had less than 4mm of Gallbladder Wall thickness, 5 patients experienced bleeding (20%). However, out of the 25 patients who had Gallbladder wall thickness equal to or more than 4 mm, 24 patients experienced bleeding (96%).

When the correlation between Gallbladder wall thickness and bleeding was ascertained by using Pearson's correlation coefficient[r] it showed 0.688 (P-Value is < .00001) establishing a strong correlation.

Table 9. Association between Gall Bladder Wall Thickness and Adhesion:

	Total Number of patients	Patients experienced difficult adhesion	Percentages
GB Wall thickness < 4 mm	25	1	4%
GB Wall thickness = > 4 mm	25	23	92%

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r= 1

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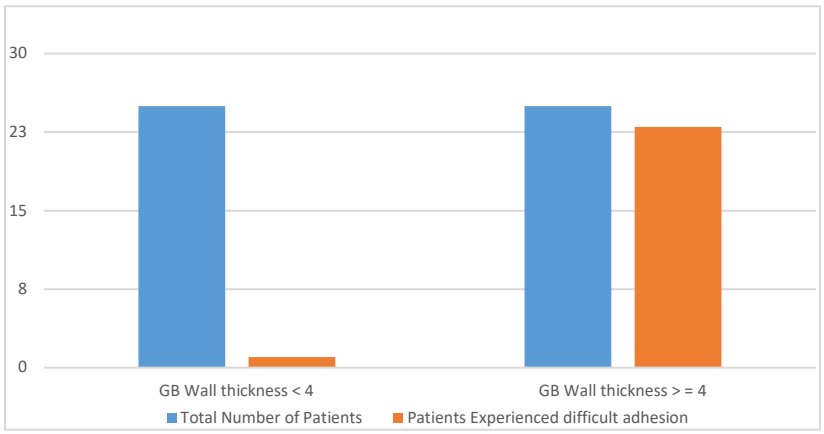
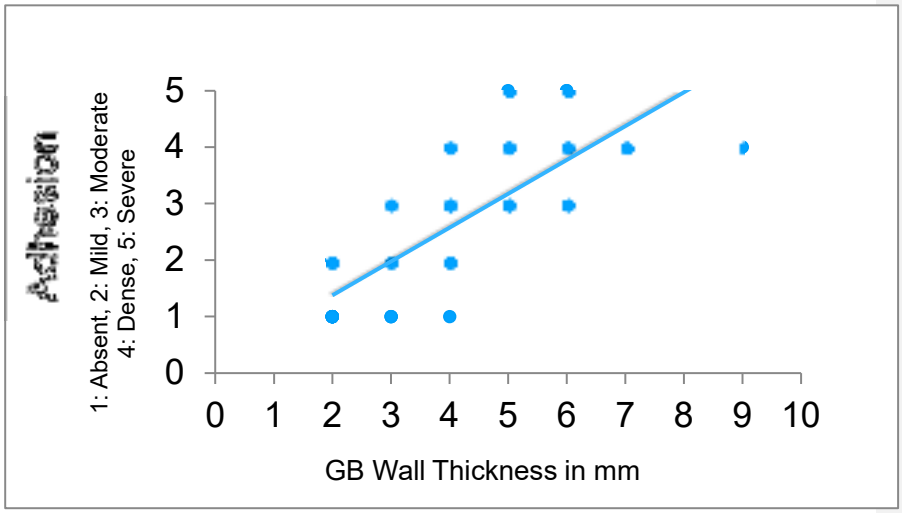


Graph 10: Bar graph showing association between Gallbladder wall thickness and intraoperative adhesions among study participants



Graph 11: Scatter graph showing correlation between Gallbladder wall thickness and intraoperative adhesions among study participants

Out of the 25 patients who had less than 4mm of Gall Bladder Wall thickness, 1 patients experienced difficult adhesion (4%). However, out of the 25 patients who had Gall Bladder wall thickness equal to or more than 4 mm, 23 patients experienced difficult adhesion (92%).

When the correlation between Gallbladder Wall Thickness and Intraoperative adhesions was ascertained by using Person's correlation coefficient it showed 1 (P-Value is < .00001) establishing a strong positive correlation. The adhesions noted for patients with thinner GB wall thickness was lower than the adhesions noted for patients with thicker GB wall thickness

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Table 10. Association between Gall Bladder Wall Thickness and Difficulty in removal of GB:

	Total Number of patients	Difficulty in removal of GB
GB Wall thickness < 4 mm	25	1 (4%)
GB Wall thickness => 4 mm	25	22 (88%)

r= 0.834

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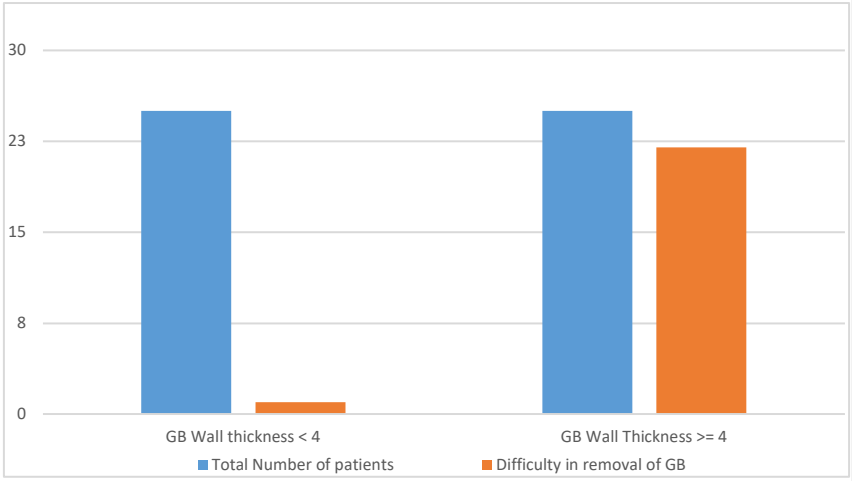

Graph 12: Bar graph showing association between Gallbladder wall thickness and difficulty in removal of gallbladder among study participants

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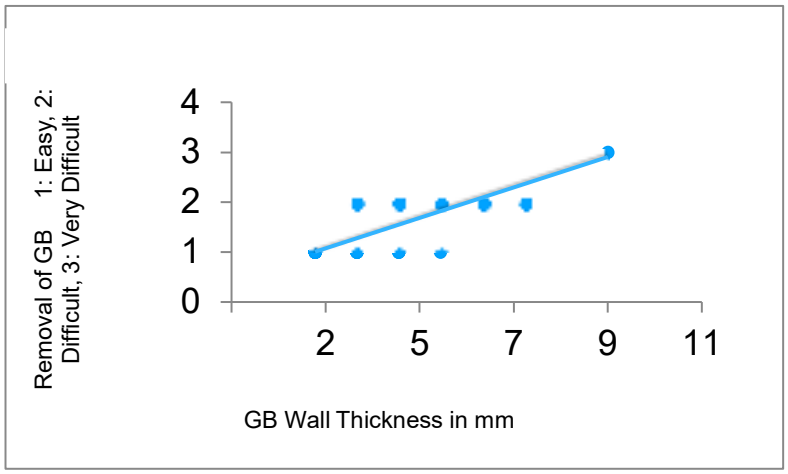

Graph 13: Scatter plot ~~graph~~ showing correlation between Gallbladder wall thickness and difficulty in gallbladder removal among study participants

Out of the 25 patients who had less than 4mm of Gallbladder Wall thickness, 1 patient had difficult removal of GB (4%). However, out of the 25 patients who had Gallbladder wall thickness equal to or more than 4 mm, 22 patients had difficult GB removal (88%).

When the correlation between Gallbladder wall thickness and difficulty in removal was ascertained by using Pearson's correlation coefficient it showed 0.834 (P-Value is < .00001) establishing a strong correlation.

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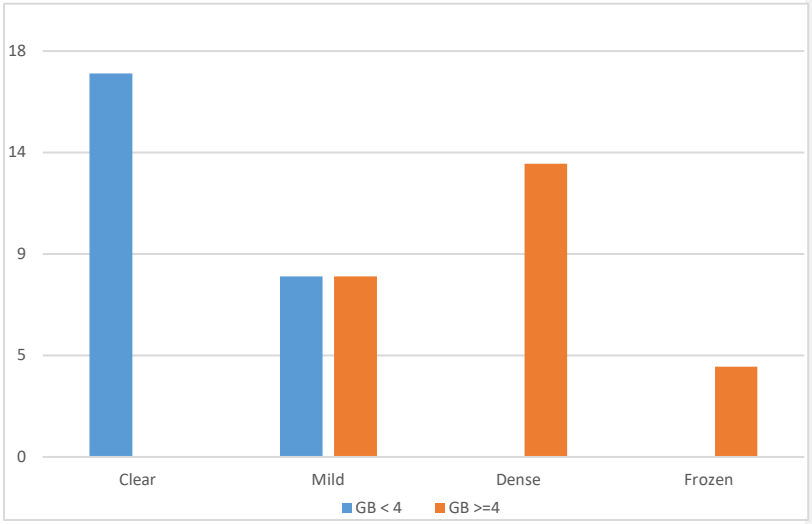
Table 11. Association between Gall Bladder Wall Thickness and Anatomy of Calot:

	Clear	Mild	Dense	Frozen
GB Wall thickness < 4 mm	17 (68%)	8 (32%)	0 (0%)	0 (0%)
GB Wall thickness => 4 mm	0 (0%)	8 (32%)	13 (52%)	4 (16%)

r= 0.744



Graph 14: Bar graph showing association between Gallbladder wall thickness and anatomy of Calot's triangle among study participants

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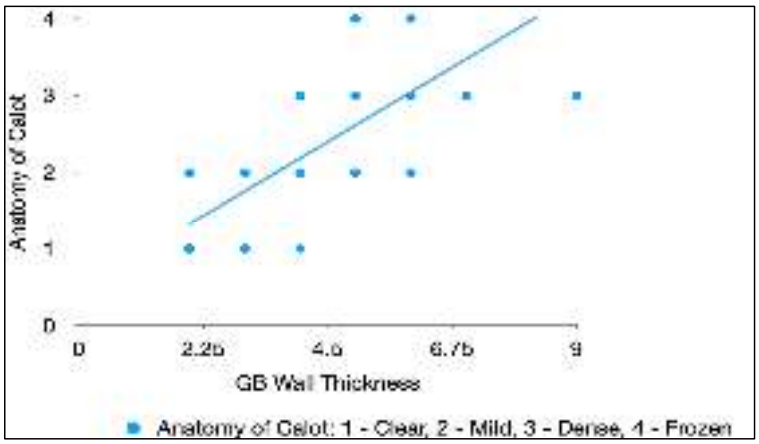

Graph 15: Scatter plot ~~graph~~ showing correlation between Gallbladder wall thickness and anatomy of Calot among study participants

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Out of the 25 patients who had less than 4mm of Gall Bladder Wall thickness, 17 patients had clear anatomy of calot (68%) and 8 (32%) patients had mild anatomy of calot. However, out of the 25 patients who had Gallbladder wall thickness equal to or more than 4 mm, 0 patient had clear anatomy of Calot (0%), 8 patients had mild (32%), 13 patients had Dense (52%) and 4 patients had Frozen (16%).

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When the correlation between Gallbladder wall thickness and anatomy of Calot was ascertained by using Pearson's correlation coefficient it showed 0.744 (P-Value is < .00001) establishing a strong correlation.

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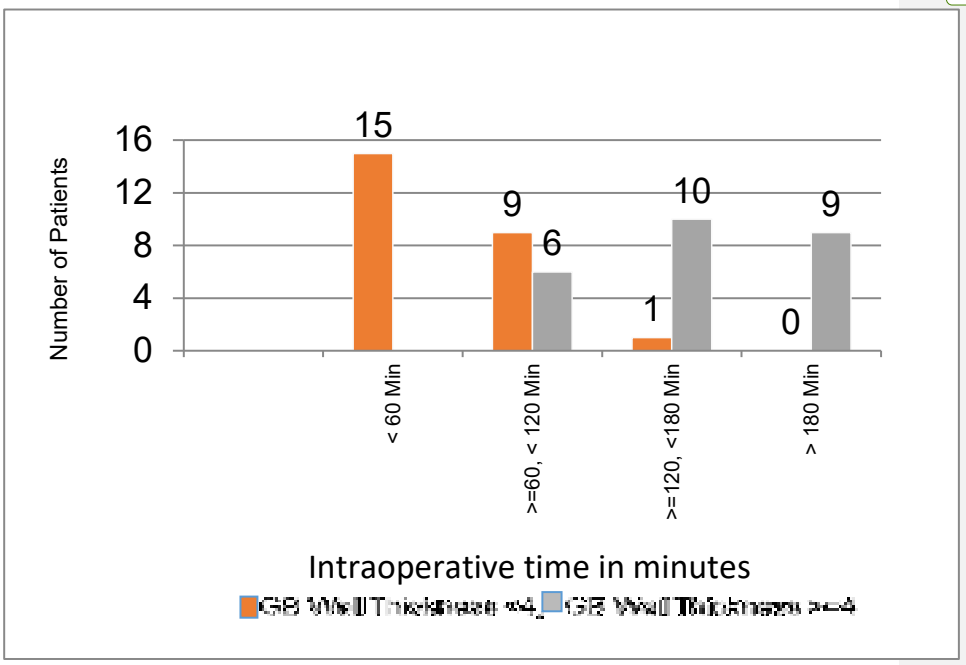
Table 12. Association between Gall Bladder Wall Thickness and Intraoperative Time:

	Operative Time < 60 Min	Operative time >=60, <120	Operative time >=120, <180	Operative Time >=180
GB Wall thickness < 4 mm	15	9	1	0
GB Wall thickness => 4 mm	0	6	10	9

r= 1



Graph 16: Bar graph showing association between Gallbladder wall thickness and Intraoperative time among study participants

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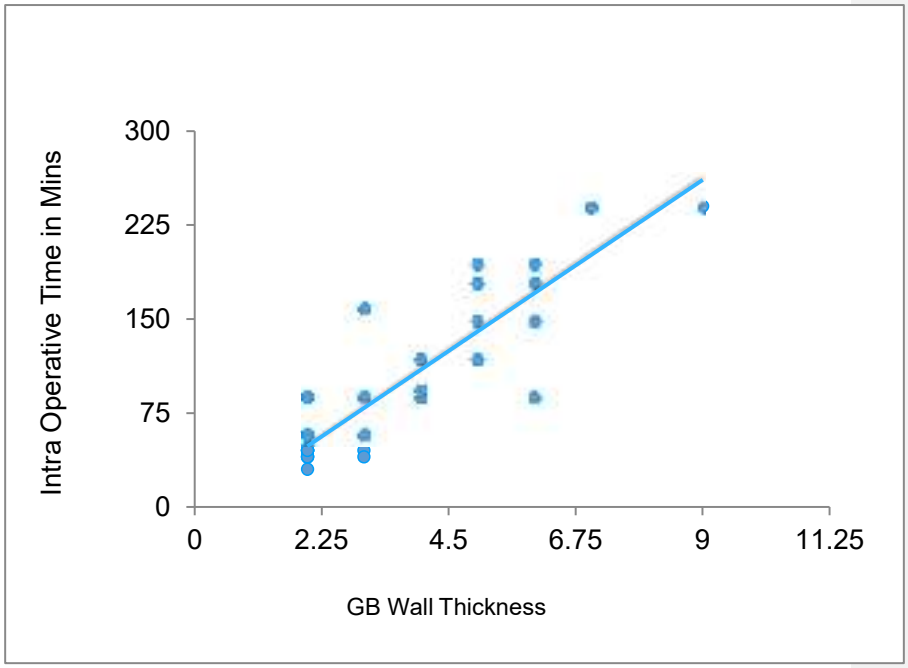

Graph 17: Scatter plot ~~Bar graph~~ showing correlation between Gallbladder wall thickness and intraoperative time among study participants

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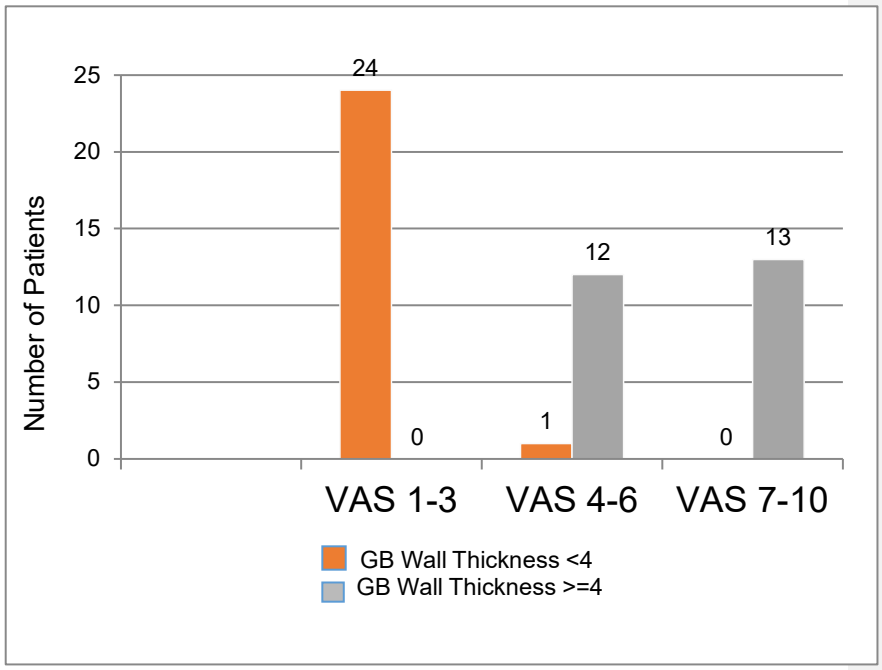
When the correlation between Gallbladder Wall Thickness and Intraoperative time was ascertained by using Person's correlation coefficient it showed 1 (P-Value is < .00001) establishing a strong positive correlation. The intraoperative time for patients with thinner GB wall thickness was lower than the intraoperative time for patients with thicker GB wall thickness

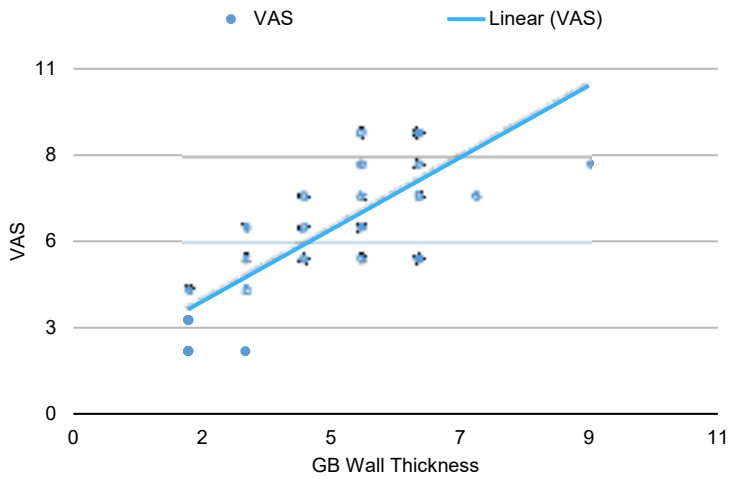
Table -13. Association between Gall Bladder Wall Thickness and Postoperative pain (VAS):

	VAS 1-3	VAS 4-6	VAS 7-10
GB Wall thickness < 4 mm	24 (96%)	1 (4%)	0 (0%)
GB Wall thickness => 4 mm	0 (0%)	12 (48%)	13 (52%)

r= 0.832



Graph 18: Bar graph showing association between Gallbladder wall thickness and postoperative pain (VAS) among study participants



Graph 19: Scatter~~-~~ plot ~~Diagram~~ showing correlation between GB Wall Thickness and Postoperative pain

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Out of the 25 patients who had less than 4mm of Gall Bladder Wall thickness, 24 patients had VAS of 1-3 (96%) and 1 patient had VAS of 4-6 (4%). However, out of the 25 patients who had Gall Bladder wall thickness equal to or more than 4 mm, 12 patients had VAS of 4-6 (48%) and 13 patients had VAS of 7-10 (52%).

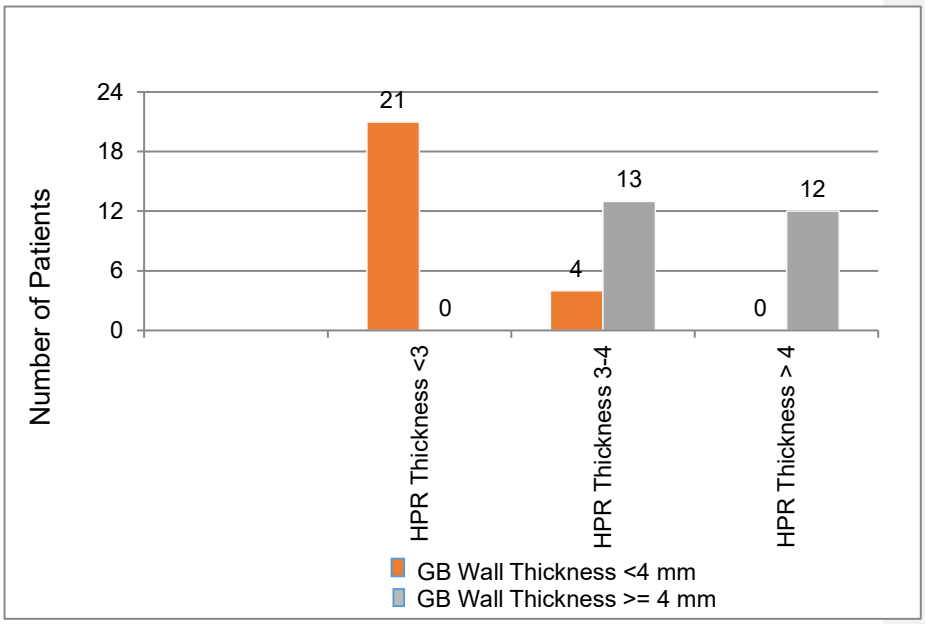
When the correlation between Gall bladder wall thickness and Postoperative pain was ascertained by using Pearson's correlation coefficient it showed 0.832 (P-Value is < .00001) establishing a strong correlation.

Association between Gall Bladder Wall Thickness and conversion to open surgery:

- No patient in this study underwent conversion to open surgery. Thus the relation of gallbladder wall thickness and conversion to open surgery was not assessed.

Table 14. Association between Gall Bladder Wall Thickness and HPR Thickness:

	HPR Thickness < 3	HPR Thickness of 3-4	HPR Thickness of > 4
GB Wall thickness < 4 mm	21 (84%)	4 (16%)	0 (0%)
GB Wall thickness => 4 mm	0 (0%)	13 (52%)	12 (48%)



Graph 20: Bar graph showing association between Gallbladder wall thickness on ultrasonography and HPR thickness of gallbladder among study participants

Out of the 25 patients who had less than 4mm of Gall Bladder Wall thickness, 21 patients had HPR Thickness of less than 3 (84%) and 4 patient had HPR Thickness of 3-4 (16%) and no patient had HPR Thickness of greater than 4. However, out of the 25 patients who had Gallbladder wall thickness equal to or more than 4 mm, no patient had HPR Thickness of less than 3 (0%), 13 patients had HPR Thickness of 3-4 (52%) and 12 patients had HPR Thickness of greater than 4 (48%).

DISCUSSION

In this study the majority of participants were females. The male to female ratio of this study was 1:2.1. This is consistent with another study conducted by Nidoni et al.[95] which showed preponderance in females with male to female ratio of 1: 1.76. However a study conducted by Giuseppe Di Buono et al. [96] failed to show any significant difference between the genders and a male to female ratio of 1:1.1. Other studies have demonstrated that male gender is at risk of difficult cholecystectomy, showing a higher rate of conversion to open surgery.[97-103]

In present study the most common age group affected was 51-60 years (mean age: 49.82 years). A study by Randhawa et al[104] showed increased difficulty of surgery in patients above 50 years of age. Similarly study by Nidoni[95] demonstrated significant difficulties in patients above 60 years with high rate of conversion to open surgery. Another study by Kama et. al.[70] showed that elderly age is a significant predictor for difficult surgery. Study by T. Pavlidis et al. [73] concluded that elderly patients are at higher risk of difficult laparoscopic cholecystectomy attributed to long-lasting gallstone presence which produces dense adhesions.

In our study the predominant clinical presentation was pain in abdomen in 54% participants followed by pain in abdomen with vomiting in 34% participants. In history of comorbidities the predominant history was of hypertension (10%) and diabetes mellitus (6%) however 31 participants (62%) showed no clinically significant history.

In study conducted by Daradkeh et al[105] demonstrated that Preoperative ultrasonography can detect the size of the GB, the number of GB stones, the size of the stones, the location of GB stones, the thickness of the GB wall, the diameter of the CBD, and the size of the liver, all of which can be predictors for difficult laparoscopic cholecystectomy. Another important entity is presence of impacted GB stone. These stones are notorious for causing inflammation and subsequent fibrosis at the site of impaction. This can result in intra operative difficulty to grasp the gallbladder neck and creating issues in adequate exposure of Calot's triangle. Another important cause of surgical difficulty may be adhesions which cannot be assessed on preoperative ultrasonography.

In present study the preoperative ultrasonography demonstrated that about 54% participants had multiple stones, stone size of ≥ 10 mm in 64% participants and gallbladder thickness of ≥ 4 mm in 50% participants. Studies have demonstrated that higher size of stone have been associated with difficult LC. [106, 107] A study by Lal et al[106] showed that thickened gallbladder wall was linked with higher rate of conversion to open surgery thus being a predictor of difficult LC. Multiple studies [113,117] have demonstrated similar findings. Intraoperatively the assessment of time taken for surgery, evidence of biliary or stone spillage, incidence of bleeding or perforation, difficult dissection of Calot's triangle, difficult extraction of GB and need for conversion were considered determinants of difficult LC.

In this study about 96% of participants with thickened gallbladder wall demonstrated bleeding intraoperatively as opposed to 20% participants with gallbladder wall <4mm in thickness. There was a significant correlation between

thickened gallbladder wall and bleeding intraoperatively. This bleeding usually arises from the cystic artery as a result of difficulties in dissection of Calot's triangle. This is consistent with other studies [103,107,112] which assessed the relation of thickened gallbladder wall with difficult LC.

In present study patients with thickened gallbladder wall showed dense adhesions (92%) and difficulty in their removal (88%). Our study showed a strong correlation of gallbladder wall thickness and adhesions encountered intraoperatively (r=1). A study by Santambrogio[14] showed significant correlation of thickened gallbladder wall and adhesions thus making it a predictor for difficult LC. It also reported an increased rate of conversion in patients with thickened gallbladder wall. This is in accordance with reports of other studies by Daradkeh et al.[105], Alponat et al.[108], Jansen S et al.[109] and Chen RC et al.[110]

A significant correlation was noted in our study between gallbladder wall thickness and difficult dissection of GB from liver surface (r=0.834). This may be attributed to the difficulty in grasping the gallbladder and retraction due to increased fibrosis. Previous studies such as by Urbano et al.[112] and others have also demonstrated that increased gallbladder thickness increases difficult extraction of gallbladder.[97,109,112,113]

A study by Sanabria JR et al.[98] reported severe adhesions in calot's triangle and showed that it had most serious problem among all difficult LC cases. These cases had longer operation time and showed a higher conversion rate. Our study had findings consistent to this and reported significant correlation in thickened gallbladder

wall and difficult dissection of Calot's triangle (r=0.744). In study by Lal et al.[106] the difficulty to dissect was attributed to dense adhesions with the surrounding structures and in Calot's triangle in patients with thickened gallbladder wall. Studies by Gabriel R et al.[113] and Singh et al.[114] also reported similar findings.

In this study a strong correlation was noted with gallbladder wall thickness and intraoperative time (r=1). Dense adhesions and difficult calot's triangle dissection has been attributed to prolonged operative time. According to a study conducted by Haji et al.[90] a significant association was noted between gallbladder wall thickness and prolonged operative time. These findings were concurred by other studies by Ranjith et al.[115], Vivek et al.[116] and Prabhu et al.[117]

However a study by Carmody et al[118] did not find any significant relation between preoperative ultrasonography and predictor of difficult LC. Another study by Agrawal N et al.[119] showed no significant correlation between the GB wall thickness and the difficulty level of surgery.

A significant association is noted between the gallbladder wall thickness and postoperative pain (r=0.832). This is a good indicator of postoperative outcome in cases with difficult LC. This can be attributed to intraoperative events of difficult dissection and prolonged operative time. Postoperative use of analgesics is also impacted in patients. A study by Ure et al[120] concluded that though laparoscopic cholecystectomy is a relatively painless procedure there is a significant association of pain to intraoperative events and hence 24 hour monitoring for pain is essential in patients undergoing laparoscopic cholecystectomy. However not many studies have

analysed the impact of gallbladder wall thickness on postoperative pain and our study is one of few analysing this component of postoperative outcome.

Our study failed to show any correlation of preoperative ultrasonography assessed gallbladder wall thickness and postoperative histopathological report. This is consistent with a study done by Nikolaos et al.[121] which aimed to determine correlation of preoperative ultrasonography detected gallbladder wall thickness and histopathology report but failed to demonstrate any significant correlation. There is variability and discrepancy noted between imaging and histopathologic measurements. This can be attributed to some subjectivity of radiology and pathology experts, when they examine the organ. Also studies have demonstrated that during histological processing an average of 11% shrinkage can occur between fresh and pathologic specimens due to formalin or other types of fixation used.[122,123]

CONCLUSION

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Based on the findings of present study it can be concluded that preoperative ultrasonographic findings of increased gall bladder wall thickness ≥ 4 mm is an effective predictor of difficult laparoscopic cholecystectomy. It is significantly associated with intraoperative events such as increased adhesions over GB, difficult dissection of Calot's triangle, difficult extraction of GB and prolonged operative time. It is also a significant predictor of postoperative outcome like postoperative pain.

LIMITATIONS

Our study had a relatively small sample size and was conducted in a single tertiary care center. In our study no case of conversion was noted and hence the relation of ultrasonography in predicting the conversion rate was not assessed. This is an important factor for predicting operative difficulty of laparoscopic cholecystectomy.

Multicentric studies with a larger sample needs to be conducted to give better insight in the precise role of preoperative ultrasonography in predicting difficult laparoscopic cholecystectomy

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SUMMARY

Though laparoscopic cholecystectomy is accepted as gold standard treatment for cholelithiasis, certain factors can account for a difficult laparoscopic cholecystectomy. These hamper the postoperative outcome for patients. Ultrasonography is greatly helpful to characterise the appearance of gallbladder. This study was aimed to determine the usefulness of preoperative ultrasonography to predict surgical outcomes in patients planned for laparoscopic cholecystectomy.

It also aimed to measure the correlation of preoperative factors with intraoperative findings which may assist in predicting difficult laparoscopy.

This was a hospital based prospective study conducted in the department of Ganeral surgery at Dr. Prabhakar Kore Hospital and MRC, Belagavi. The period of study was from January 2020 to February 2021. A total of 50 participants with right hypochondriac pain and diagnosed to have cholelithiasis on ultrasonography were enrolled in the study with proper consent. The important findings are as follows:

- 83% of participants were females
- Majority of participants were in age group of 51-60years of age
- Pain in abdomen was the predominant complaints among the participants
- About 54% participants presented with multiple stones
- About 50% participants demonstrated thickened gallbladder wall of ≥ 4 mm
- 96% of participants with thickened wall(r=0.688) showed increased intraoperative bleeding. A significant correlation was noted with participants with thickened gallbladder wall and intraoperative bleeding.

- Adhesions were noted in 92% participants with thickened gallbladder wall. A strong positive correlation noted between the thickness of gallbladder and intraoperative adhesions (r=1).
- A statistically significant correlation was noted between participants with thickened gallbladder wall and difficulty in extraction of gallbladder (88% participants, r=0.834)
- In comparison with participants with normal gallbladder wall those with thickened wall showed increased difficulty in dissection at Calot's triangle(r=0.744, $p<0.00001$)
- A very strong positive correlation was noted between the thickness of gallbladder wall and the intraoperative time (r=1). Participants with thickened gallbladder wall showing prolonged operative time. This was attributed to difficult intraoperative events.
- This study was one of the preliminary studies to assess the correlation of postoperative pain and gallbladder wall thickness. A strong correlation was noted(r=0.832). This is a predictive factor to understand operative outcomes and also to predict the analgesic use.

Our study concluded that preoperative ultrasonography can determine factors such as thickness of gallbladder wall, stone size and number which are important predictors for difficult laparoscopic cholecystectomy. A gallbladder wall thickness of ≥ 4 mm is associated with increased intraoperative bleeding, increased adhesions, difficult calot's triangle dissection, difficult gallbladder extraction and prolonged operative time. It is also a significant predictor of postoperative outcome like postoperative pain.

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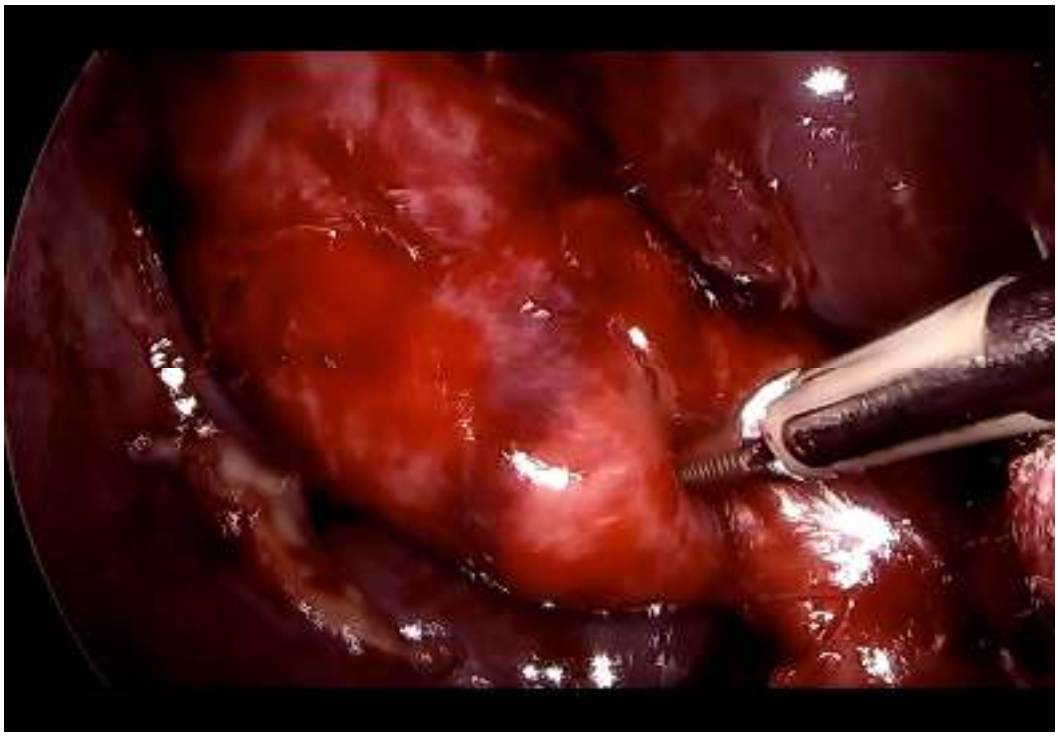
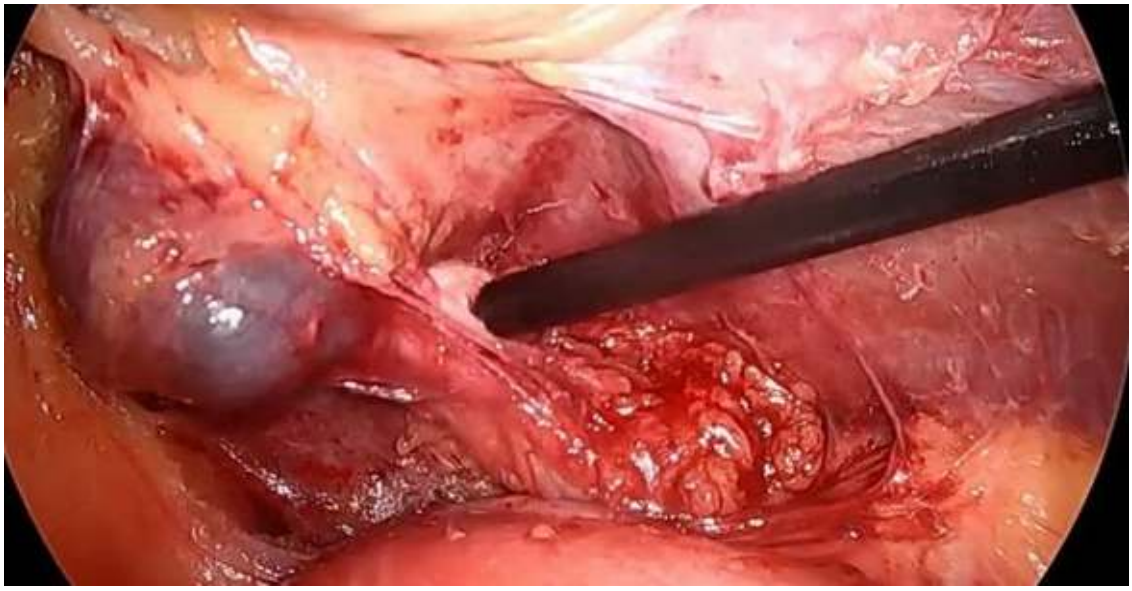
ANNEXURE I: PHOTOGRAPHS

Photograph 3: Laparoscopic instruments

Photograph 4: Laparoscopic cholecystectomy setup



Photograph 5: Difficult laparoscopic cholecystectomy



Photograph 6: Edematous gallbladder with adhesions in difficult laparoscopic cholecystectomy

ANNEXURE II

INFORMED CONSENT

Purpose of the study

I have been informed by **REG NO. BH0119005,** Post Graduate in M.S. General Surgery under the guidance of Dr. _____, Professor Department of General Surgery, J.N. Medical College, KAHER, Belagavi is conducting a study regarding Gall bladder wall thickness and operative outcome of laparoscopic cholecystectomy in treatment of Cholelithiasis at KLE's Dr. Prabhakar Kore Charitable Hospital and Medical Research Centre, Belagavi-590010.

Laparoscopic cholecystectomy is a gold standard in management of symptomatic gall stone disease. However there are incidences of intraoperative complications like bleeding, adhesions, conversion to open surgery, bile leak and post operative complications like surgical site infection, pain and prolonged hospital stay. Many of studies have identified gallbladder wall thickness as an independent risk factor for increased complications. However the degree of gall bladder wall thickness and its implications have not been assessed thoroughly. Development predictive factors for complications and conversion is very important as it would greatly benefit surgeon preparedness as well as the patient's expectations. This study aims at determining the relation of degree of gall bladder wall thickness and outcomes of laparoscopic cholecystectomy.

Study procedure

Once you have signed the informed consent, necessary personal information and detailed medical history will be taken by the investigator. USG report will be studied and operative procedure will be monitored. Postoperative monitoring of pain

with Visual Analog Scale (VAS) and wound for any evidence of infection and postoperative Histopathologic will be studied. Follow up will be recorded till 15 days.

Potential risks

This is a purely observational study and no risks are expected.

Financial incentive for participation

You will not receive any payment for taking part in this study.

Alternatives

Your participation in this study is entirely voluntary. You are free to refuse to participate or withdraw from the study at any time. You will still receive standard medical care from the hospital. The investigator holds the right to terminate the study at any time

Privacy

To protect your privacy, all the collected information will be given a number rather than using your name. Any information collected during the study will remain confidential. Your medical files will be reviewed only at the hospital (or study doctor's office) to check the information and verify the result without breaking your confidentiality.

Authorization to publish results

The information about you will be analysed together with other study participants. Results of this study will be published and presented to scientific groups for scientific purposes, but you will never be individually identified in the presentation of the study results.

Institutional policy

In case you have any questions related to the study, in future or in case of study related injury or illness, you can contact **REG NO. BH0119005**, Department of

General Surgery, J.N Medical College, Dr. _____, Professor Dept. Of General surgery, J.N Medical College, Belagavi.

Voluntary participation

Your participation in the study is voluntary. In case you need any further information regarding your rights as study participant, you may contact Dr. Roopa M Bellad, Professor of Paediatrics, as Chairman of J. N. Medical College Institutional Ethics Committee on Human Subjects Research, Phone No.0831 2473777 ext-1527 at J. N. Medical College, Belagavi. You are free to stop participation in this study at any time and for any reason.

CONSENT FORM

Study title: GALL BLADDER WALL THICKNESS AND OPERATIVE OUTCOME OF LAPAROSCOPIC CHOLECYSTECTOMY IN TREATMENT OF CHOLELITHIASIS : A ONE YEAR PROSPECTIVE STUDY AT KLE'S DR. PRABHAKAR KORE CHARITABLE HOSPITAL AND MEDICAL RESEARCH CENTRE, BELAGAVI-590010.

Please initial box

i. I confirm that I have read and understood the information sheet for the above study and have had the opportunity to ask questions. ☐

ii. I understood that my participation in the study is voluntary and that I am free to withdraw at any time, without giving any reason, without my medical care or legal rights being affected. ☐

iii. I understood that sponsor of the clinical trial, others working on the sponsor's behalf, the Ethics Committee and the regulatory authorities will not need my permission to look at my health records both in respect of current study and any further research that may be conducted in relation to it, even if I withdraw from the trial. I agree to this access. However, I understood that my identity will not be revealed in any information released to third parties or published. ☐

iv. I agree not to restrict the use of any data or results that arise from this study provided such a use is only for scientific purposes. ☐

v. I agree to take part in the above study. ☐

Subject's name:

Signature / left thumb impression of subject: Date:

Name of person obtaining informed consent:

Signature of person obtaining informed consent:

(If a patient has limited ability to read and write, an impartial witness should be present during the entire informed consent discussion and patient's legally acceptable representative should sign on the patient's behalf.) In these instances the patient his/her thumb impression taken in place of signature.

Patient's legally acceptable representative's statement: NA

I, as the patient's legally acceptable representative was present during the consenting procedure and understand the preceding information describing this study. All of the questions regarding the study and the patient's participation in it have been answered to my satisfaction. I state that all aspects of the study were clearly presented during the consent procedure. The patient is willing to participate in this study and I sign below on his/her behalf testifying to this effect.

Name of the patient:

Name of representative:

Relationship to the patient:

Signature of representative: Date:

Impartial witness declaration:

By signing the consent form I attest that the information was accurately explained to and apparently understood by the patient and the representative (if applicable) and that the informed consent was freely given by the patient.

Name of impartial witness:

Signature: Date –

ANNEXURE III. ETHICAL CLEARANCE.

K.L.E. ACADEMY OF HIGHER EDUCATION AND RESEARCH
(Deemed - to - be-University)
Accredited 'A' Grade by NAAC (2nd Cycle) Placed in Category 'A' by MHRD (GoI)
JAWAHARLAL NEHRU MEDICAL COLLEGE,
NEHRU NAGAR, BELAGAVI-590010 (KARNATAKA-INDIA)
Website: http://www.jnmc.edu
E-Mail : dome@jnmc.edu
Phone: (+91-0831) Office : 2472550
Principal: 2471701
Fax No. +91 (0831) - 2470759

Ref: MDC/DOME/281 Date: 24/12/2019

To,

REG NO. BH0119005

PG student in Surgery,
J.N.Medical College,
BELAGAVI.

Sub: Institutional Ethical Clearance for the study.

With reference to the above, we wish to inform you that your proposed research project titled **"GALL BLADDER WALL THICKNESS AT PREOPERATIVE SONOGRAPHY AND ITS IMPACT ON OPERATIVE OUTCOME OF LAPAROSCOPIC CHOLECYSTECTOMY: A ONE YEAR PROSPECTIVE STUDY AT KAHER'S PRABHAKAR KORE HOSPITAL AND MRC"**, is ethical and justifiable. The proposed research project has been cleared by the JNMC Institutional Ethics Committee on Human Subjects Research.

(Dr. Anita Dalal)
Member Secretary
JNMC Institutional Ethics Committee
on Human Subjects Research,
J.N.Medical College, Belagavi.

(Dr. Roopa M Bellad)
Chairman,
JNMC Institutional Ethics Committee
on Human Subjects Research,
J.N.Medical College, Belagavi.

ANNEXURE IV – PROFORMA

SCREENING FORM

1. Patient's UHID no.: ☐☐☐☐☐☐

2. Age (in years): ☐☐

3. Gender: 1. Male ☐ 2.Female ☐

4. Height (in cms): ☐☐☐

5. Weight (in kgs): ☐☐

6. BMI(kg/m²): ☐☐

7. History : Onset of symptoms:

1.Acute: ☐

2.Chronic: ☐

8. CONDITIONS:

1. HYPERTENSION: YES ☐ On treat ☐

NO ☐

2. DIABETES MELLITUS: 1. Yes ☐

2. No ☐

9. Previous Abdominal Surgery: 1. Yes ☐

2. No ☐

10. On Examination:

Pain/tenderness: 1. Yes ☐

2. No ☐

11. DOA (dd/mm/yy) ☐☐☐☐☐☐

12. DOD (dd/mm/yy) ☐☐☐☐☐☐

13. Date of interview (dd/mm/yy) ☐☐☐☐☐☐

14. Address : 1. Belagavi ☐

2. Outside Belagavi ☐

15. Phone: ☐☐☐☐☐☐☐☐☐☐

16.Occupation : 1-Unemployed ☐

2-Unskilled ☐

3-Semi-skilled ☐

4-Skilled ☐

5-Professional ☐

17.Education : 1-Illiterate ☐

2-Primary (1st-7th std) ☐

3-High school (8th-10th std) ☐

4-Intermediate ☐

5-Degree and above ☐

18.Socio-economic status 1-Low ☐

2-Middle ☐

3-High ☐

19.Applicant is willing to give consent : 1-Yes ☐

2-No ☐

20.Final result: 1-Ineligible ☐

2-Eligible but refused ☐

3-Eligible and participating ☐

INVESTIGATIONS:

21. Investigations: USG (gall bladder wall thickness):

1. <3mm ☐
2. 3-4mm ☐
3. >4mm ☐

22. Workup for surgery:

1. Complete blood count
2. Renal and Profile
3. Liver function Tests
4. HbsAg
5. PT/INR
6. ECG
7. Chest X-ray
8. Viral Markers

ANALYSIS

Intraoperative:

1. Intra operative time: ☐☐ HR ☐☐ MIN

2. Bleeding. 1) Yes ☐

2) No ☐

3. Conversion to open surgery: 1) Yes ☐

2) No ☐

4. Gallbladder Perforation. 1) Yes ☐

2) No ☐

5. Creation of Pneumoperitoneum. 1) Closed ☐

2) Open ☐

6 Appearance of Gall Bladder : 1) Normal ☐

2) Enlarged ☐

3) Inflammed ☐

7. Adhesions over GB: 1) Absent ☐

2) mild(covering only neck, fundus visible) ☐

3) moderate (covering GB) ☐

4) severe(buried GB) ☐

8. Releasing adhesions: 1) Easy ☐

2) Difficult ☐

9. Anatomy of Calot's : 1) clear ☐

2)mild adhesions ☐

3) dense adhesions ☐

4) Frozen GB ☐

10. Removal of GB from Liver bed: 1) Easy ☐

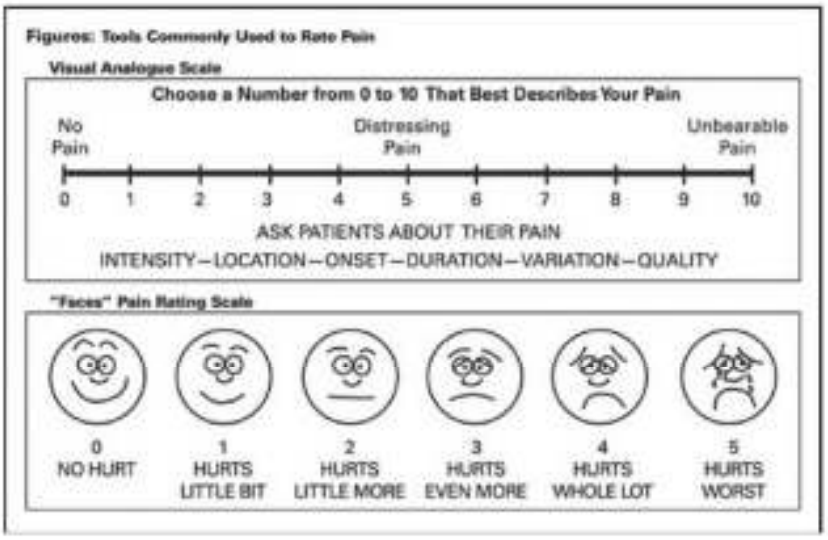
2) Difficult ☐

11.Need for Drain. 1) Yes ☐

2) No ☐

Postoperative:

1) Postoperative pain : by using Visual Analogue Scale ☐



2) Postoperative hospital stay : Number of Days ☐☐

3) Infection: 1. Yes ☐

2. No ☐

HISTOPATHOLOGICAL REPORT:

1) Gross: 1. Size

2. Thickness:- 1. <3mm ☐

2. 3-4mm ☐

3. >4mm ☐

2) Microscopy: 1. Benign: Acute ☐

Chronic ☐

2. Malignant: 1) Yes ☐

2) No ☐

Table 1

SR NO:	IP NO:	Demographic details				SYMPTOMS	Past history		General physical examination				USG findings			Investigations	Operation details		Bleeding	Perforation	Pneumoperitoneum	Adhesions over GB	Releasing Adhesions	Anatomy of Calot	Removal of GB	Drain	VAS	Infection	HPR findings				
		Age	Gender	DOA	DOD		Comorbidities	Previous surgeries		Vitals			Number of stones	Size of largest stone	GB wall thickness		Date of surgery	Intraoperative time			Closed/ Open	Absent/Mild/ Mod/Severe	Easy/Difficult	Clear/Mild/Dense/Frozen	Easy/Difficult	Yes/No	Yes/No	NO	HPR thickness			Micro	
									Icterus	Pulse rate	BP	Per abdomen																NO	<3	3-4	>4	Benign	
																												NO				Acute	Chronic
1	993238	54	MALE	2-1-2020	13-1-2020	PAIN ABDOMEN	NONE	NONE	NO	84	110/70	SOFT, TENDERNESS IN RIGHT HYPOCHONDRIUM	3	5X3.2 MM	3	HB- 14.7, LFT-WNL,	9-1-2020	90MINS	NO	NO	CLOSED	MILD	EASY	MILD	EASY	NO	5	NO	TRUE	FALSE	FALSE	FALSE	TRUE
2	993251	60	FEMALE	2-1-2020	22-1-2020	PAIN ABDOMEN, VOMITING	NONE	TUBECTOMY	NO	80	130/70	SOFT, TENDERNESS IN RIGHT HYPOCHONDRIUM	4	1.1X1.7CM	6	13.1, LFT- WNL	11-1-2020	195MINS	YES	NO	CLOSED	MODERATE	DIFFICULT	DENSE	DIFFICULT	YES	7	NO	FALSE	FALSE	TRUE	FALSE	TRUE
3	995102	60	FEMALE	11-1-2020	17-1-2020	PAIN ABDOMEN	HYPOTHYROIDISM HTN	TUBECTOMY	NO	72	120/80	SOFT, TENDERNESS IN RIGHT HYPOCHONDRIUM	MULTIPLE	1 CM	4	12.9, LFT-WNL	13-1-2020	1HR 45 MIN	YES	NO	OPEN	MILD	EASY	DENSE	DIFFICULT	NO	5	NO	FALSE	TRUE	FALSE	FALSE	TRUE
4	997826	24	FEMALE	26-1-2020	31-1-2020	PAIN ABDOMEN, VOMITING	NONE	APPENDECTOMY , LSCS, TUBECTOMY	NO	72	120/80	GUARDING RIGIDITY IN RIGHT HYPOCHONDRIUM, TENDERNESS+	MULTIPLE	4 X 2 MM	2		28-1-2020	45MIN	NO	NO	CLOSED	MILD	EASY	MILD	EASY	NO	4	NO	TRUE	FALSE	FALSE	FALSE	TRUE
5	997939	47	FEMALE	27-1-2020	29-1-2020	PAIN ABDOMEN, INCREASED BURPING	NONE	LSCS, TUBECTOMY	NO	80	120/80	NAD	3		2	14.5, LFT-WNL	28-1-2020	45MINS	NO	NO	CLOSED	ABSENT	EASY	CLEAR	EASY	NO	2	NO	TRUE	FALSE	FALSE	FALSE	TRUE
6	997953	51	MALE	27-1-2020	4-2-2020	PAIN ABDOMEN, FEVER	NONE	NONE	NO	80	122/80	SOFT, TENDERNESS IN RIGHT HYPOCHONDRIUM	MULTIPLE	3X2 MM	3	15.7, LFT-WNL	31-1-2020	1 HR 30 MINS	NO	NO	CLOSED	ABSENT	EASY	CLEAR	EASY	NO	4	NO	TRUE	FALSE	FALSE	FALSE	TRUE
7	1002916	29	FEMALE	22-2-2020	7-3-2020	PAIN ABDOMEN, VOMITING	NONE	NONE	NO	92	100/70	SOFT, TENDERNESS IN RIGHT HYPOCHONDRIUM	MULTIPLE	6MM	5	11.6, LFT-WNL	3-3-2020	2HR 30 MIN	YES	YES	OPEN	MODERATE	DIFFICULT	DENSE	DIFFICULT	YES	8	NO	FALSE	FALSE	TRUE	FALSE	TRUE
8	1002992	58	FEMALE	23-2-2020	25-2-2020	PAIN ABDOMEN	HTN, DM	HYSTERECTOMY	NO	82	130/80	SOFT, TENDERNESS IN RIGHT HYPOCHONDRIUM	SINGLE	4 X 2 MM	2	11.9, LFT- WNL	24-2-2020	40MINS	NO	NO	CLOSED	ABSENT	EASY	CLEAR	EASY	NO	3	NO	TRUE	FALSE	FALSE	FALSE	TRUE
9	1003067	35	FEMALE	24-2-2020	12-3-2020	PAIN ABDOMEN, VOMITING	NONE	NONE	NO	80	120/80	SOFT, TENDERNESS IN RIGHT HYPOCHONDRIUM	FEW	9MM	4	11.3, LFT-WNL	25-2-2020	2HRS	YES	NO	CLOSED	MODERATE	DIFFICULT	DENSE	DIFFICULT	NO	6	NO	FALSE	TRUE	FALSE	FALSE	TRUE
10	1003149	50	FEMALE	24-2-2020	26-2-2020	PAIN ABDOMEN, VOMITING	HYPOTHYROIDISM	TUBECTOMY, HEMORRHOIDECTOMY	NO	82	110/70	SOFT, TENDERNESS IN RIGHT HYPOCHONDRIUMPREV SURG SCAR +	MULTIPLE	2CM	2	13.2, LFT- WNL	25-2-2020	30 MINS	YES	NO	CLOSED	MILD	EASY	MILD	EASY	NO	4	NO	TRUE	FALSE	FALSE	FALSE	TRUE
11	1005795	76	MALE	7-3-2020	11-3-2020	PAIN ABDOMEN	DM	LEFT INGUINAL HERNIA	NO	82	130/70	SOFT, NONTENDER	MULTIPLE	5MM	2	14.7, LFT-WNL	9-3-2020	40MINS	NO	NO	CLOSED	ABSENT	EASY	CLEAR	EASY	NO	2	NO	TRUE	FALSE	FALSE	FALSE	TRUE
12	1006348	55	FEMALE	11-3-2020	20-3-2020	PAIN ABDOMEN	HTN	TUBECTOMY	NO	80	130/80	SOFT, TENDERNESS IN RIGHT HYPOCHONDRIUMPREV SURG SCAR +	MULTIPLE	1.4cms	6	11.3, LFT-WNL	16-3-2020	1HRS30MINS	BLEEDING	NO	CLOSED	MODERATE	DIFFICULT	MILD	DIFFICULT	NO	5	NO	FALSE	TRUE	FALSE	FALSE	TRUE
13	1006277	55	MALE	11-3-2020	14-3-2020	PAIN ABDOMEN	NONE	NONE	NO	76	120/80	SOFT, TENDERNESS IN RIGHT HYPOCHONDRIUM,RIGHT INGUINAL SWELLING	MULTIPLE		3	11, LFT-WNL	13-3-2020	45MINS	NO	NO	CLOSED	ABSENT	EASY	CLEAR	EASY	NO	2	NO	TRUE	FALSE	FALSE	FALSE	TRUE
14	1006360	54	MALE	11-3-2020	13-3-2020	UMBILICAL SWELLING	HTN	NONE	NO	84	140/90	REDUCIBLE, UMBILICAL SWELLING WITH POSITIVE COUGH IMPULSE	MULTIPLE		3	15.1, LFT- WNL	12-3-2020	2HRS 40MINS	YES	YES	CLOSED	MODERATE	DIFFICULT	MILD	DIFFICULT	NO	6	NO	FALSE	TRUE	FALSE	FALSE	TRUE
15	1007292	56	FEMALE	16-3-2020	23-3-2020	PAIN ABDOMEN, FEVER, VOMITNG	HTN	NONE	NO	74	124/80	SOFT, TENDERNESS IN RIGHT HYPOCHONDRIUM	MULTIPLE		5	13.9, LFT-WNL	17-3-2020	2HRS	YES	NO	CLOSED	MODERATE	DIFFICULT	DENSE	DIFFICULT	YES	7	NO	FALSE	FALSE	TRUE	FALSE	TRUE
16	1014533	65	FEMALE	12-6-2020	19-6-2020	PAIN ABDOMEN, VOMITING	HTN	NONE	NO	84	120/80	SOFT, TENDERNESS IN EPIGASTRIC REGION	SINGLE	1.9CM	4	10.8, LFT-WNL	15-6-2020	1 HR 30MINS	NO	NO	CLOSED	MODERATE	DIFFICULT	MILD	DIFFICULT	NO	6	NO	FALSE	TRUE	FALSE	FALSE	TRUE
17	1017362	50	FEMALE	2-7-2020	7-7-2020	PAIN ABDOMEN	NONE	NONE	NO	64	120/70	SOFT, TENDERNESS IN RIGHT HYPOCHONDRIUM	MULTIPLE	8X7MM	2	12, LFT-WNL	3-7-2020	45 MINS	NO	NO	CLOSED	ABSENT	EASY	CLEAR	EASY	NO	2	NO	TRUE	FALSE	FALSE	FALSE	TRUE
18	1018016	50	FEMALE	7-7-2020	12-7-2020	PAIN IN ABDOMEN	HTN, HYPOTHYROIDISM	NONE	NO	82	110/80	SOFT, NONTENDER	SINGLE	1 CM	2	13.9, LFT- WNL	9-7-2020	50 MIN	NO	NO	CLOSED	ABSENT	EASY	CLEAR	EASY	NO	2	NO	TRUE	FALSE	FALSE	FALSE	TRUE
19	1018489	78	FEMALE	11-7-2020	18-7-2020	PAIN IN ABDOMEN, VOMITING	NONE	NONE	NO	78	120/80	SOFT, TENDERNESS	MULTIPLE	6 X 4 MM	2	13.3, LFT- WNL	16-7-2020	40MIN	NO	NO	CLOSED	ABSENT	EASY	CLEAR	EASY	NO	2	NO	TRUE	FALSE	FALSE	FALSE	TRUE
20	1020412	25	MALE	6-8-2020		PAIN ABDOMEN, VOMITING	NONE	ESWL FOR RENAL CALCULI	NO	74	126/80	SOFT, TENDERNESS IN RIGHT HYPOCHONDRIUM	MULTIPLE	8 x 6MM	4	11.2, LFT- WNL	10-8-20	2HRS	YES	NO	CLOSED	MODERATE	DIFFICULT	DENSE	DIFFICULT	NO	6	NO	FALSE	TRUE	FALSE	FALSE	TRUE
21	1022507	35	MALE	5-9-2020	16-9-2020	PAIN ABDOMEN	NONE	NONE	NO	90	120/70	SOFT, TENDERNESS IN RIGHT HYPOCHONDRIUM	MULTIPLE	8MM	5	16.7, LFT- WNL	9-9-2020	3 HRS	YES	YES	CLOSED	DENSE	DIFFICULT	FROZEN	DIFFICULT	YES	7	NO	FALSE	TRUE	FALSE	FALSE	TRUE
22	1025195	40	FEMALE	12-10-2020	16-10-2020	PAIN ABDOMEN	NONE	NONE	NO	78	120/70	SOFT, NON TENDER	SINGLE	5MM	2	12.1, LFT- WNL	14-10-2020	45MINS	NO	NO	CLOSED	ABSENT	EASY	CLEAR	EASY	NO	2	NO	TRUE	FALSE	FALSE	FALSE	TRUE
23	1025416	58	MALE	14-10-2020	23-10-2020	PAIN ABDOMEN	HTN	NONE	NO	84	140/80	SOFT, TENDERNESS IN RIGHT HYPOCHONDRIUM	SINGLE	2 x 1CM	4	12.8, LFT-WNL	17-10-2020	2HRS	NO	NO	CLOSED	ABSENT	EASY	CLEAR	EASY	NO	7	NO	FALSE	TRUE	FALSE	FALSE	TRUE
24	1026400	70	MALE	27-10-2020	4-11-2020	PAIN ABDOMEN, VOMITING	NONE	NONE	NO	96	120/80	SOFT, NON TENDER	MULTIPLE	5MM	6	12.5, LFT- WNL	28-10-2020	3 HRS	YES	YES	CLOSED	DENSE	DIFFICULT	FROZEN	DIFFICULT	NO	9	NO	FALSE	FALSE	TRUE	FALSE	TRUE
25	1026806	68	MALE	1-11-2020	5-11-2020	PAIN ABDOMEN	HTN, HYPOTHYROIDISM, DM	NONE	NO	98	130/80	SOFT, NON TENDER	MULTIPLE	9MM	6	11.7,LFT-WNL	2-11-2020	2.30HRS	YES	YES	CLOSED	DENSE	DIFFICULT	DENSE	DIFFICULT	NO	8	NO	FALSE	FALSE	TRUE	FALSE	TRUE

26	**1026816**	47	FEMALE	1-11-2020	5-11-2020	PAIN ABDOMEN, VOMITING	NONE	LSCS + TUBECTOMY	NO	62	130/70	SOFT, TENDERNESS IN RIGHT HYPOCHONDRIUM	SINGLE	4 X3 MM	4	12.3, LFT- WNL	3-11-2020	1 HR 45MIN	YES	NO	CLOSED	MODERATE	DIFFICULT	MILD	DIFFICULT	NO	5	NO	FALSE	TRUE	FALSE	FALSE	TRUE
27	**1005621**	53	FEMALE	6-3-2020	16-3-2020	PAIN ABDOMEN	NONE	NONE	NO	72	120/70	SOFT, TENDERNESS IN RIGHT HYPOCHONDRIUM	MULTIPLE	8MM	4	13.4, LFT- WNL	14-3-2020	2HRS	YES	NO	CLOSED	DENSE	DIFFICULT	DENSE	DIFFICULT	NO	6	NO	FALSE	TRUE	FALSE	FALSE	TRUE
28	**1016514**	32	FEMALE	26-6-2020	5-7-2020	PAIN ABDOMEN, VOMITING	NONE	NONE	NO	88	118/76	SOFT, TENDERNESS IN RIGHT HYPOCHONDRIUM	MULTIPLE	1.3 x0.5 CM	4	11.5, LFT- WNL	30-6-20	1 HR 30 MIN	NO	NO	CLOSED	MILD	DIFFICULT	MILD	EASY	NO	6	NO	FALSE	TRUE	FALSE	FALSE	TRUE
29	**1015201**	54	FEMALE	17-6-2020		PAIN ABDOMEN	DM	HYSTERECTOMY	NO	80	130/80	SOFT, TENDERNESS IN RIGHT HYPOCHONDRIUM	SINGLE	1.2 X 0.4 CM	6	11.4, LFT- WNL	19-6-2020	2HR 30 MIN	YES	NO	CLOSED	SEVERE	DIFFICULT	DENSE	DIFFICULT	YES	8	NO	FALSE	FALSE	TRUE	FALSE	TRUE
30	**1016063**	39	FEMALE	23-6-2020	7-7-2020	PAIN ABDOMEN	NONE	ANGIOPLASTY, OP/C/O RENAL STONES	NO	87	120/70	SOFT, TENDERNESS IN RIGHT HYPOCHONDRIUM	SINGLE	1.4 X0.5 CM	6	14.3, LFT-WNL	29-6-2020	3HRS	YES	YES	OPEN	SEVERE	DIFFICULT	DENSE	DIFFICULT	YES	9	NO	FALSE	FALSE	TRUE	TRUE	FALSE
31	**1015894**	34	FEMALE	22-6-2020	29-6-2020	PAIN ABDOMEN, VOMITING	NONE	TUBECTOMY	NO	80	120/80	SOFT, TENDERNESS IN RIGHT HYPOCHONDRIUM	SINGLE	6MM	4	10.2, LFT- WNL	25-6-2020	1HR 30MINS	YES	NO	CLOSED	MILD	EASY	MILD	EASY	NO	6	NO	FALSE	TRUE	FALSE	FALSE	TRUE
32	**1003662**	51	FEMALE	26-2-2020	18-3-2020	ABDOMINAL FULLNESS	NONE	TUBECTOMY	NO	68	140/90	SOFT, TENDERNESS IN RIGHT HYPOCHONDRIUM, PREV SURGERY SCAR	MULTIPLE	9MM	2	12.4,LFT- WNL	9-3-2020	1HR	NO	NO	CLOSED	MILD	EASY	MILD	EASY	NO	4	NO	TRUE	FALSE	FALSE	FALSE	TRUE
33	**1024041**	19	FEMALE	25-9-2020	30-9-2020	PAIN IN ABDOMEN	NONE	NONE	NO	72	110/70	SOFT, TENDERNESS IN RIGHT HYPOCHONDRIUM	SINGLE	4MM	5	11.8, LFT- WNL	28-9-2020	2HRS	YES	NO	CLOSED	DENSE	DIFFICULT	MILD	DIFFICULT	NO	5	NO	FALSE	TRUE	FALSE	FALSE	TRUE
34	**1034854**	60	MALE	12-1-2021	27-1-2021	PAIN ABDOMEN, VOMITING	NONE	APPENDICECTOMY	NO	70	120/70	SOFT, TENDERNESS IN RIGHT HYPOCHONDRIUM, PREV SURGERY	2	7.5 X 5.6MM	2	15.6,LFT- WNL	23-1-2021	1HR	NO	NO	CLOSED	ABSENT	EASY	MILD	EASY	NO	3	NO	TRUE	FALSE	FALSE	FALSE	TRUE
35	**1029693**	60	MALE	30-11-2020	12-12-2020	PAIN IN ABDOMEN, VOMITING	NONE	NONE	NO	74	130/70	SOFT, TENDERNESS IN RIGHT HYPOCHONDRIUM	2	2MM	4	13.6, LFT- WNL	3-12-2020	1HR 45MINS	YES	NO	CLOSED	MILD	DIFFICULT	MILD	DIFFICULT	NO	5	NO	FALSE	TRUE	FALSE	FALSE	TRUE
36	**1030583**	45	MALE	8-12-2020	11-12-2020	PAIN ABDOMEN	NONE	NO	NO	86	130/70	SOFT, TENDERNESS IN RIGHT HYPOCHONDRIUM	MULTIPLE	8X4MM	3	16.4,LFT- WNL	9-12-2020	40 MINS	NO	NO	CLOSED	ABSENT	EASY	CLEAR	EASY	NO	4	NO	TRUE	FALSE	FALSE	FALSE	TRUE
37	**1029945**	74	MALE	2-12-2020	4-12-2020	PAIN ABDOMEN	DM, HTN	HEMORRHOIDECTOMY	NO	84	130/90	SOFT, NONTENDER	SINGLE	1CM	2	13.5, LFT - WNL	3-12-2020	45MINS	NO	NO	CLOSED	MILD	EASY	CLEAR	EASY	NO	3	NO	TRUE	FALSE	FALSE	FALSE	TRUE
38	**1030474**	67	MALE	7-12-2020	14-12-2020	PAIN ABDOMEN	NONE	?LIPOMA EXCISION	NO	78	120/80	SOFT, TENDERNESS IN RIGHT HYPOCHONDRIUM	SINGLE	5MM	3	10.9, LFT- WNL	11-12-2020	1 HR	YES	NO	CLOSED	MILD	EASY	MILD	EASY	NO	5	NO	FALSE	TRUE	FALSE	FALSE	TRUE
39	**1034024**	45	FEMALE	6-1-21	11-1-21	PAIN ABDOMEN	NONE	TUBECTOMY	NO	88	130/90	SOFT, TENDERNESS IN EPIGASTRIC REGION	SINGLE	2 X 0.7CMS	2	12.9, LFT- WNL	7-1-21	45MINS	NO	NO	CLOSED	ABSENT	EASY	CLEAR	EASY	NO	4	NO	TRUE	FALSE	FALSE	FALSE	TRUE
40	**1034364**	48	MALE	8-1-21	16-1-21	PAIN ABDOMEN	NONE	APPENDECTOMY	NO	72	110/70	SOFT, TENDERNESS IN RIGHT HYPOCHONDRIUM	MULTIPLE	13MM	7	14.7, LFT- WNL	12-1-21	4 HR	YES	NO	OPEN	DENSE	VERY DIFFICULT	DENSE	DIFFICULT	NO	7	NO	FALSE	FALSE	TRUE	FALSE	TRUE
41	**1035155**	36	FEMALE	15-1-21	20-1-21	PAIN ABDOMEN	BRONCHIAL ASTHMA	APPENDECTOMY	NO	72	120/70	SOFT, TENDERNESS IN RIGHT HYPOCHONDRIUM, PREV SCAR +	FEW	9 X 4MM	2	10.5, LFT- WNL	18-1-21	40MINS	NO	NO	CLOSED	ABSENT	EASY	CLEAR	EASY	NO	4	NO	TRUE	FALSE	FALSE	FALSE	TRUE
42	**1034985**	45	FEMALE	13-1-21	25-1-21	PAIN ABDOMEN	NONE	APPENDECTOMY , TUBECTOMY	NO	80	130/90	SOFT, NONTENDER, PREV SURG SCAR+	SINGLE	6.7MM	5	10.6, LFT- WNL	18-1-21	3HRS	YES	NO	OPEN	DENSE	DIFFICULT	DENSE	DIFFICULT	NO	6	NO	FALSE	FALSE	TRUE	FALSE	TRUE
43	**1035586**	50	FEMALE	19-1-21	25-1-21	PAIN IN ABDOMEN	HYPOTHYROIDISM, OSTEOARTHRITIS	NONE	NO	82	120/80	SOFT, TENDERNESS IN RIGHT HYPOCHONDRIUM	SINGLE	2CM	2	11.9, LFT- WNL	22-1-21	45 Mins	NO	NO	CLOSED	ABSENT	EASY	CLEAR	EASY	NO	3	NO	TRUE	FALSE	FALSE	FALSE	TRUE
44	**1026403**	47	FEMALE	27-10-2020	14-11-2020	PAIN IN ABDOMEN, VOMITING, LOOSE STOOLS	NONE	TUBECTOMY	NO	90	120/70	SOFT, TENDERNESS IN RIGHT HYPOCHONDRIUM	MULTIPLE	2MM	3	12.7, LFT- WNL	1-11-2020	1HR	YES	NO	OPEN	MILD	EASY	MILD	EASY	NO	5	NO	TRUE	FALSE	FALSE	FALSE	TRUE
45	**1035914**	44	FEMALE	20-1-21	4-2-21	PAIN IN ABDOMEN, VOMITING	DM, COPD	NONE	NO	72	110/70	SOFT, TENDERNESS IN RIGHT HYPOCHONDRIUM	TWO	2 CM	5	10.9, LFT- WNL	25-1-21	3HRS 15MINS	YES	YES	CLOSED	SEVERE	DIFFICULT	FROZEN	DIFFICULT	YES	9	NO	FALSE	FALSE	TRUE	FALSE	TRUE
46	**1033696**	42	FEMALE	4-1-21	9-1-21	PAIN IN ABDOMEN, VOMITING	NONE	LAP TUBAL LIGATION	NO	90	120/80	SOFT, TENDERNESS IN RIGHT HYPOCHONDRIUM	MULTIPLE	1MM	5	12.7, LFT-WNL	6-1-21	3HRS	YES	YES	OPEN	MODERATE	DIFFICULT	FROZEN GB	DIFFICULT	YES	7	NO	FALSE	FALSE	TRUE	FALSE	TRUE
47	**1034551**	68	FEMALE	9-1-2021	19-1-2021	PAIN ABDOMEN	HYPOTHYROIDISM	HEMORRHOIDECTOMY, FIBROADENOMA EXCISION	NO	80	130/90	SOFT, NON TENDER , SWELLING IN UNBILICAL REGION	SINGLE	5MM	5	13, LFT- WNL	15-1-2021	2HRS	YES	NO	CLOSED	MODERATE	DIFFICULT	MILD	EASY	NO	5	NO	FALSE	FALSE	TRUE	FALSE	TRUE
48	**1026001**	30	FEMALE	21-10-2020	23-10-2020	PAIN IN ABDOMEN	HYPOTHYROIDISM	LSCS	NO	88	140/80	SOFT, NONTENDER	SINGLE	3MM	2	11, LFT- WNL	22-10-2020	1.30 HRS	YES	NO	CLOSED	MILD	EASY	NONE	EASY	NO	3	NO	TRUE	FALSE	FALSE	FALSE	TRUE
49	**1037191**	40	FEMALE	29-1-21	2-2-21	PAIN ABDOMEN, VOMITING	NONE	HEMORRHOIDECTOMY, LSCS	NO	86	120/70	SOFT, TENDERNESS IN RIGHT HYPOCHONDRIUM	MULTIPLE	9.4 X 4.6 MM	9	6.8, LFT- WNL	25-1-21	4HRS	YES	YES	CLOSED	DENSE	DIFFICULT	DENSE	VERY DIFFICULT	YES	8	NO	FALSE	FALSE	TRUE	FALSE	TRUE
50	**1037708**	58	FEMALE	2-2-21	6-2-21	PAIN ABDOMEN	DM	NONE	NO	80	110/70	SOFT, NON TENDER	MULTIPLE	5MM	2	13.4, LFT-WNL	3-2-21	1HR	NO	NO	OPEN	MILD	EASY	NONE	EASY	NO	4	NO	TRUE	FALSE	FALSE	FALSE	TRUE

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