

**A STUDY ON
THE PREOPERATIVE PREDICTION OF A DIFFICULT
LAPAROSCOPIC CHOLECYSTECTOMY**

**A DISSERTATION SUBMITTED TO
THE TAMILNADU DR.M.G.R MEDICAL UNIVERSITY**

*In partial fulfillment of the regulations for the award of the
Degree of M.S., (GENERAL SURGERY)*

BRANCH – I



**DEPARTMENT OF GENERAL SURGERY
STANLEY MEDICAL COLLEGE AND HOSPITAL
THE TAMILNADU DR.M.G.R MEDICAL UNIVERSITY
CHENNAI**

APRIL 2014

CERTIFICATE

This is to certify that the dissertation entitled
**“A STUDY ON THE PREOPERATIVE PREDICTION OF A
DIFFICULT LAPAROSCOPIC CHOLECYSTECTOMY”** is the
bonafide work done by **Dr. G. SOUNDARYA**, Post Graduate student
in the Department of General Surgery, Government Stanley
Medical College and Hospital, Chennai, 2011- 2014 under my direct
guidance and supervision, in partial fulfillment of the regulations of
The Tamil Nadu Dr. M.G.R Medical University, Chennai for the
award of **M.S., Degree (General Surgery) Branch - I**, Examination
to be held in April 2014.

Prof. A. RAJENDRAN, M.S.,
Professor ,
Dept. of General Surgery,
Stanley Medical College,
Chennai-600001.

Prof. K. KAMARAJ, M.S.,
Professor and Head ,
Dept. of General Surgery,
Stanley Medical College ,
Chennai-600001.

PROF. S. GEETHA LAKSHMI, M.D., PhD,
The Dean,
Stanley Medical College,
Chennai-600001.

DECLARATION

I, **Dr. G.SOUNDARYA**, solemnly declare that this dissertation titled “**A STUDY ON THE PREOPERATIVE PREDICTION OF A DIFFICULT LAPAROSCOPIC CHOLECYSTECTOMY**” is a bonafide work done by me in the Department of General Surgery, Government Stanley Medical College and Hospital, Chennai, under the guidance and supervision of my unit chief, **Prof. A. RAJENDRAN, M.S.**, and the Head of my Department, **Prof. K. KAMARAJ, M.S.**

This dissertation is submitted to The Tamilnadu Dr. M.G.R. Medical University, Chennai in partial fulfillment of the university regulations for the award of M.S., Degree (General Surgery) Branch-I, Examination to be held in April 2014.

Place: Chennai.

Date: December 2013.

DR. G.SOUNDARYA.

ACKNOWLEDGEMENT

I am deeply indebted to my guide **Prof. A. Rajendran**, Professor of Surgery for his support, encouragement and valuable advice which has brought out the best in me.

I owe a lot to my Assistant Professors **Dr. P. Balaji, Dr. G. V. Manoharan, Dr. G. Venkatesh, Dr. G. Vignesh and Dr. Jim Jebakumar** for their constant guidance and inspiration without which the study could not have been possible.

I consider it a privilege to have done this study under the supervision of my beloved Professor and Head of the Department **Prof. K. Kamaraj**, who has been a constant source of support.

I express my sincere gratitude to my mentor **Prof. S. Deivanayagam**, former Head of the Department of General Surgery for his inspiring words and able guidance which remained a constant support throughout my course and I am extremely thankful to him.

I am grateful to the Dean **Prof. S. Geethalakshmi** for permitting me to conduct the study and use the resources of the College.

It is my earnest duty to thank my parents without whom accomplishing this task would have been impossible.

I am extremely thankful to my patients who consented and participated to make this study possible.

CONTENTS

S. NO.	CHAPTER	PAGE NO
1.	INTRODUCTION	1
2.	REVIEW OF LITERATURE	4
3.	AIMS AND OBJECTIVES	54
4.	MATERIALS & METHODS	55
5.	OBSERVATION AND RESULTS	60
6.	DISCUSSION	71
7.	CONCLUSION	77
8.	BIBLIOGRAPHY	
9.	ANNEXURE (i) PROFORMA (ii) INSTITUTIONAL ETHICAL COMMITTEE APPROVAL CERTIFICATE (iii) MASTER CHART (iv) TURNITIN SCREEN SHOT (v) PATIENT INFORMATION SHEET (vi) CONSENT FORM	

ABSTRACT

A STUDY ON THE PREOPERATIVE PREDICTION OF A DIFFICULT LAPAROSCOPIC CHOLECYSTECTOMY

Introduction

Laparoscopic cholecystectomy has become the standard operative procedure for cholelithiasis, but there are still some patients requiring conversion to open cholecystectomy mainly because of technical difficulty. The aim was to define the possibility of prediction of a difficult outcome preoperatively.

Materials and Methodology

40 patients with symptomatic gallstones planned for elective surgery and operated upon by a single experienced laparoscopic surgeon were studied by assigning a score depending upon clinical and sonological parameters.

Results

Out of 40 cases, 11 had a difficult outcome with scores ranging between 5 and 10.

None had a score >10. Age >50, Obesity, Previous hospitalization, Palpable gallbladder and Wall thickness > 4mm on ultrasonogram were found to

significantly influence the outcome. The ideal cut off point was a score of 3, which could predict difficulty. Overall the positive predictive value was 78.57%.

Conclusion

A difficult laparoscopic cholecystectomy can be predicted preoperatively. Patients having *high risk* may be informed and scheduled appropriately. An experienced surgeon has to operate on these patients, and he or she has to make an early decision to convert in case of difficulty

Keywords

Laparoscopic cholecystectomy, prediction, risk factors.

INTRODUCTION

Biliary tract surgeries are amongst the most commonly performed ones in the abdomen.

Open cholecystectomy (OC), ever since described by Carl Langenbuch in 1882, has been the prime modality of treating gallstone disease for about a century.

The introduction of Laparoscopic cholecystectomy (LC) in 1985, by Mühe of Böblingen, Germany has revolutionised the treatment of gallstones. Having been recognised as the "gold standard" for treating gallstone disease, this has supplanted open cholecystectomy, and also ended attempts towards noninvasive management like extracorporeal shock wave lithotripsy and bile salt therapy.

In 1992, the National Institutes of Health (NIH) Consensus Development Conference stated that LC provides a safe and effective treatment for most patients with symptomatic gallstones.

The advantages of LC over OC are immediately appreciated; earlier return of bowel function, less postoperative pain, improved cosmesis, shorter hospital stay, earlier return to normal activity and decreased overall cost. Currently it is estimated that 90% of

cholecystectomies are performed by the laparoscopic approach. Indeed, LC as a mature mode of therapy has introduced the general surgical world to the advantages and unique perspectives of minimal access surgery.

Despite the charm of endoscopic surgery, the slightly higher rate of certain complications associated with laparoscopic surgery as compared to the open one, remains a setback and is a cause of scepticism among the general public.

Therefore it would be worthwhile to evaluate the possibilities of predicting the chances of a difficult laparoscopic cholecystectomy, which would ensure safety to the patient and also avoid litigation.

There have been many attempts to this approach and various parameters, clinical and radiological have been analysed and many scoring systems developed. The answer is an emphatic yes, when it comes to the question of whether a difficulty could be predicted preoperatively.

An ideal system should encompass factors proven to have an influence on the outcome, should include investigations at an optimum

cost, and the prediction should be individualised based on clinical judgement.

Much more than the score itself, it is the impact of certain factors which would ultimately determine the outcome.

The preoperative prediction aims at patient counselling and also guiding the surgeon to decide on an early conversion, should difficulty arise and also involve an experienced surgeon in the task and thereby ensure patient safety.

REVIEW OF LITERATURE

HISTORY OF THE GALL BLADDER AND GALLSTONES

The earliest known gall stones were found in the mummy of a Priestess of Arnan (1085-945 BC) by the Egyptians.

Galen (138-201AD) described the storage function of the gall bladder.

Gallstones were first described in the fifth century, by a Greek physician named Alexander Trallianus (525-605 BC). The first clinical description of the gallstone disease was given by Gordon Taylor as early as the 4th century BC [1].

Francis Glisson (1597-1677), an English anatomist believed that there must be some substance in fresh grass which dissolves gallstones. He noted that gallstones were seen in the intestines of oxen after eating winter hay and straw, but not after grazing.

Jean-Louis Petit was the first person to remove gallstones by draining the gallbladder in 1743, and from then onwards he was called the founder of gallbladder surgery.

Dr. John Stough Bobbs (1809 to 1870), a Civil War surgeon from Pennsylvania, is credited with the first cholecystostomy in 1867. To him, “The museum of surgical art is an operation theatre.

Carl Johann August Langenbuch [2] of Berlin (1846 to 1901) performed the first cholecystectomy on July 15, 1882. His principle was, “the gallbladder needs to be removed, not because it contains stones, but because it forms them”.

Bernard Naunyn in 1892 made remarkable achievements by describing the physiological basis behind gall stone formation. He stated that gallbladder stasis contributed greatly to gallstone formation on the nidus originating from sloughed out epithelial cells and other debris. He also recognised *Escherichia coli* and *Salmonella typhi* causing cholecystitis and cholangitis as contributing factors [1, 3].

On September 12, 1985 (103 years later after the description of open approach), Prof. Erich Mühe of Germany performed the first laparoscopic cholecystectomy (LC) [4].

ANATOMY

A. Embryology

The caudal region of the foregut gives rise to what is called the hepatic diverticulum during the 4th week of intrauterine life [5]. The hepatic diverticulum gives rise to the pars hepatica and pars cystica. Gall bladder develops from the latter, while the former develops into liver and extrahepatic biliary radicals and they luminate by 8th week of intrauterine life.

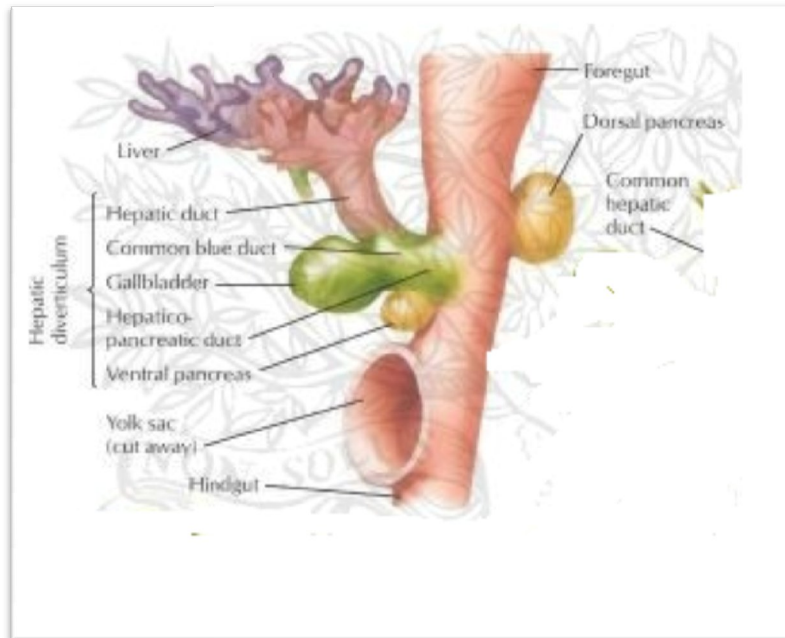


Figure 1. Embryology of Gall Bladder

B. HISTOLOGY

The gallbladder wall consists of five layers,

- i) columnar epithelium
- ii) lamina propria,

- iii) smooth muscle – with ganglia in between the smooth muscle bundles
- iv) subserosal connective tissue, and
- v) serosa.

The gallbladder lacks submucosa[6,7]. Rokitansky-Aschoff sinuses are the invaginations of epithelium into the lamina propria, muscle, and subserosal connective tissue [6, 7]. They are present in about 40% of normal gallbladders and in abundance in most inflamed gallbladders.

The ducts of Luschka are tiny bile ducts that are found around the muscle layer on the hepatic side of the gallbladder, in about 10% of normal gallbladders. They have no relation to the Rokitansky-Aschoff sinuses or to cholecystitis.

C.GROSS ANATOMY:

The gallbladder, a pear-shaped organ lies on the inferior surface of the liver at the junction of the left and right hepatic lobes between Couinaud's segments IV and V.

The gallbladder ranges from 7 to 10 cm in length and from 2.5 to 3.5 cm in width. The gallbladder's volume varies considerably between fasting states and after a meal. A moderate gallbladder has a capacity of 50 to 60 ml.

The gallbladder has been divided into four areas: the fundus, body, infundibulum, and neck. The Hartmann's pouch is an asymmetrical bulge of the infundibulum which lies close to the gallbladder's neck.

The cystic duct arises from the gallbladder, courses downward in the hepatoduodenal ligament and joins the lateral aspect of the supraduodenal portion of the common hepatic duct at an acute angle to form the common bile duct. The length of the cystic duct varies between 2 and 4 cm [6,7].

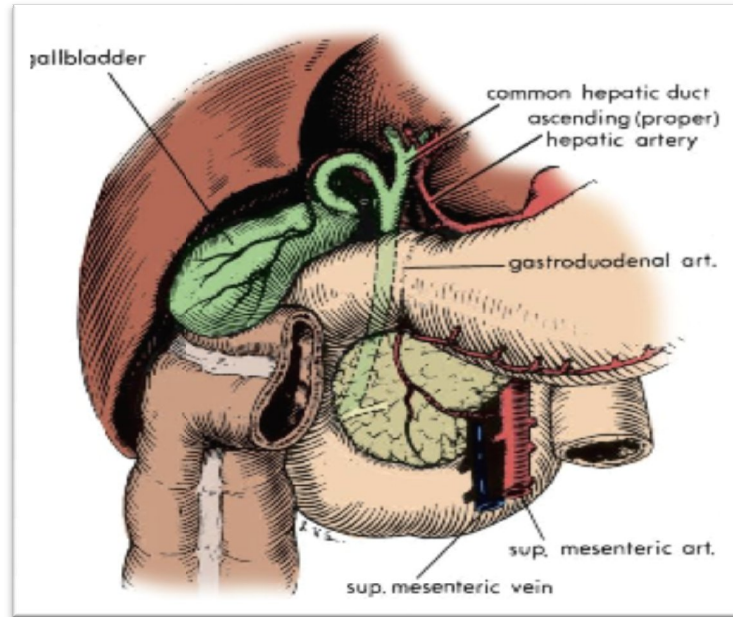


Figure 2. Biliary Anatomy

The Triangle Of Calot and The Hepatocystic Triangle Of Moosman:

Jean Francois Calot in 1891 described a triangular region having cystic artery as the superior border, common hepatic duct as the medial border and cystic duct as the lateral border [8]. Moosman's triangle on the other hand has its upper boundary formed by liver [6, 7].

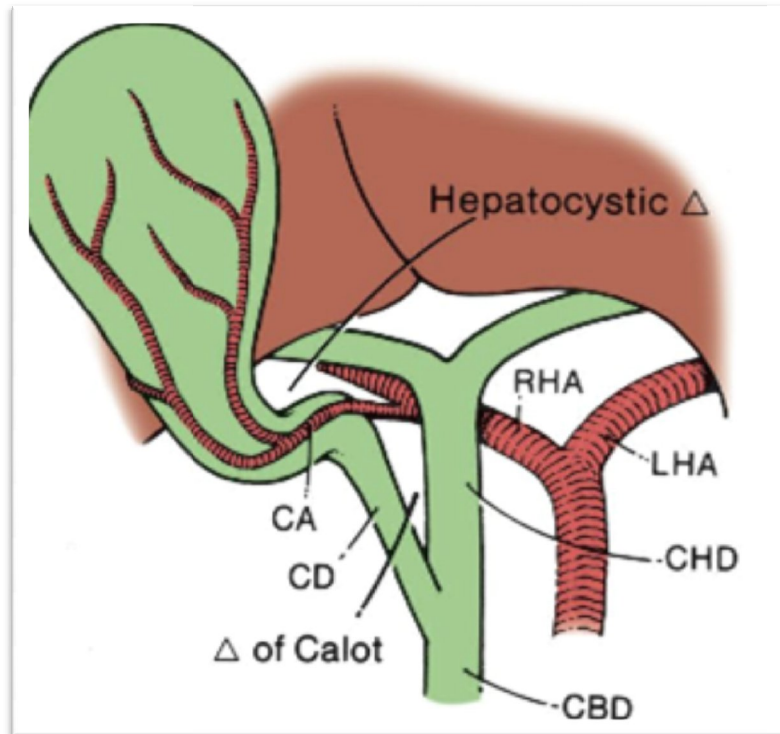


Figure 3. Calot's triangle

An aberrant right hepatic artery arising from the superior mesenteric artery may course through the medial aspect of the triangle, posterior to the cystic duct. A clear visualization of the hepatocystic triangle is essential while performing a cholecystectomy.

ARTERIAL SUPPLY AND VENOUS DRAINAGE:

Cystic artery arises from right hepatic artery and supplies the gallbladder. Rarely, it may also arise from the common hepatic, left hepatic or gastroduodenal artery. Venous drainage is by cystic veins predominantly, while some portions, especially the superior surface

drain directly into hepatic veins. Occasionally, the cystic vein may drain into the right branch of portal vein [6].

NERVE SUPPLY:

The gallbladder and biliary tree receive sympathetic and parasympathetic nerve fibres from the celiac plexus. Parasympathetic is by way of the hepatic branch of the left (anterior) vagal trunk. Sympathetic fibres arising from the 5th to the 9th thoracic segments pass through the greater splanchnic nerves to the celiac ganglion. Postganglionic sympathetic fibres accompany the hepatic artery to innervate the gallbladder, bile duct and liver [10].

Sensory fibres from the right phrenic nerve, through communications between the phrenic plexus and the celiac plexus also innervate the gallbladder, which explains the phenomenon of referred shoulder pain in patients with gallbladder disease.

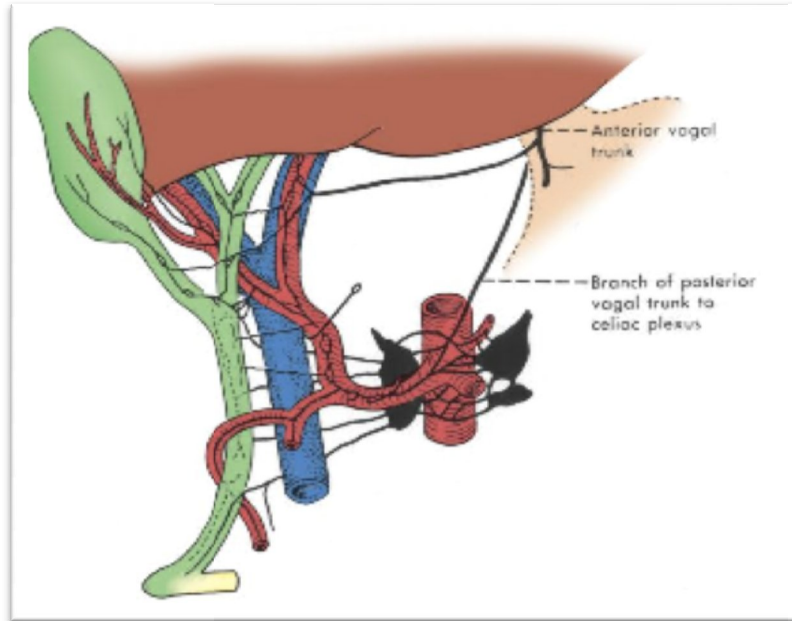


Figure 4. Innervation of the Gallbladder

ANOMALIES

A) Cystic duct

The anomalies of cystic duct which are important during a cholecystectomy were described by Benson and Page in 1976. The cystic duct may run parallel to the common hepatic duct for a variable distance (15%), or it may spiral anterior or posterior to the common hepatic duct to form a left-sided union (8%).

The cystic duct may join the right hepatic duct or a right segmental duct. Occasionally, the gallbladder may join the common hepatic duct with a short or virtually nonexistent cystic duct. During

ligation of a short cystic duct, care must be taken not to compromise the lumen of the common bile duct. [9]

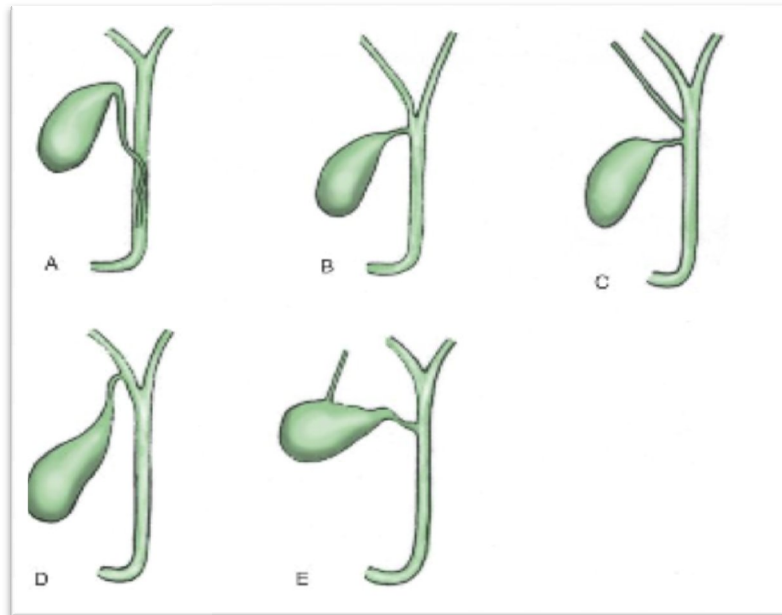


Figure 5. Cystic duct anomalies

B) Gall Bladder

- Formation
 - a. Phrygian cap
 - b. Bilobed gallbladder
 - c. Hourglass gallbladder
 - d. Diverticulum of the gallbladder
 - e. Rudimentary gallbladder

- Number
 - a. Absence of the gallbladder (agenesis)
 - b. Duplication of the gallbladder
- Position
 - a. Floating gallbladder
 - b. Intrahepatic gallbladder
 - c. Left-sided gallbladder
 - d. Transverse gallbladder
 - e. Retrodisplaced gallbladder [8]

Phrygian Cap

This is the most common anomaly of the gallbladder in which the deformity is created by an infolding of a septum between the body and the fundus. It is found more commonly in women. Boyden identified this anomaly in 18% of patients with a normally functioning gallbladder and is not an indication for cholecystectomy.

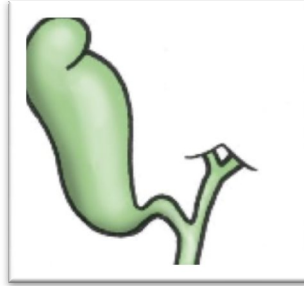


Figure 6. Phrygian cap

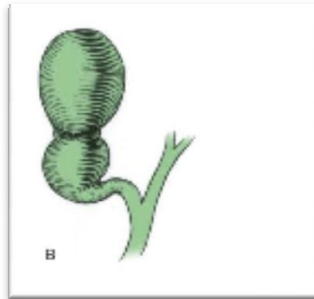


Figure 7. Hour glass Gall Bladder

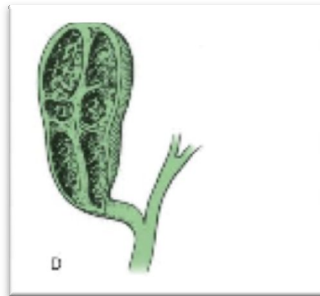


Figure 8. Bilobed Gallbladder

Bilobed Gallbladder

This occurs in two forms-one that is divided internally by a longitudinal fibrous septum, the other type appears like two separate gallbladders fused at the neck. It has no clinical importance.

Hourglass Gallbladder

This occurs as a congenital anomaly in children whereas in adults, it usually occurs as a result of chronic cholecystitis. The latter type, though not the former, requires removal.

Diverticulum of the Gallbladder

Congenital diverticula vary between 0.5 – 9cm and can arise from any part of the gallbladder. They assume significance when they contain stones, become inflamed, or perforate. On the contrary, Hartmann's pouch is an acquired diverticulum which occurs at the infundibulum or neck of the gallbladder in conditions of chronic obstruction to emptying.

Absence of the Gallbladder (Agenesis)

Around 200 cases have been reported so far. Most patients die within 6 months after birth owing to other associated anomalies. In a citation reviewing 185 such cases, 70 (38%) were completely absent, 60 (32%) were rudimentary, and 55 (30%) were a fibrous structure.

Duplication

The reported incidence is 1 in 4000 persons. A true duplicated gallbladder is found to have 2 distinct cavities each drained by a

separate cystic duct. The two cystic ducts may either unite or enter the common bile duct separately.

Floating Gallbladder

This type of gallbladder is entirely surrounded by peritoneum and is attached to the liver bed by a peritoneal reflection. It has 5% incidence. This attachment if includes only the cystic duct, the gallbladder remains unsupported. Torsion of such a gallbladder may occur in seventh decade and presents as an emergency which requires removal.

C) Vascular

Around 50% of people have variations in arterial anatomy. Double cystic arteries are found in 15-20% of people, which course through Calot's triangle and can be inadvertently injured during cholecystectomy. Triple cystic arteries are much rarer with an incidence of less than 1%.

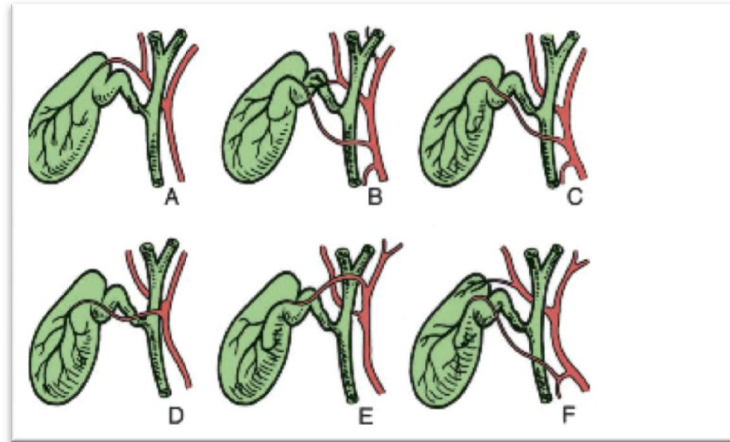


Figure 9. Anomalies of cystic artery

PHYSIOLOGY:

FUNCTIONS OF THE GALLBLADDER:

A) CONCENTRATION OF BILE:

The absorptive power of gallbladder mucosa is astonishingly great as compared to any other organ as bile gets concentrated by around five fold. Around 500-1000 ml of hepatic bile gets concentrated to a mere 30- 60ml. The main driving force for concentration of bile is the ability to actively transport Sodium and Chloride, which is followed by the passive reabsorption of water.

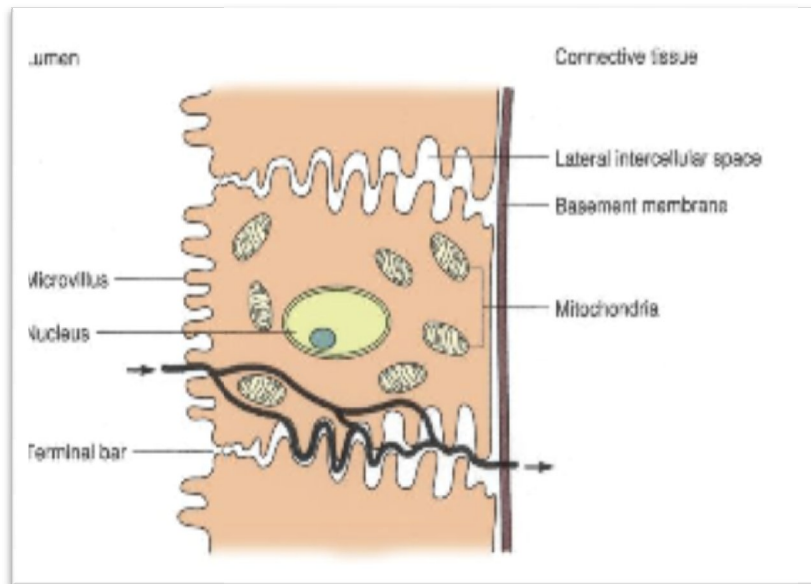


Figure 10. Gallbladder mucosal absorption

Absorption of organic compounds like bilirubin, cholesterol, phospholipids, and bile salts also occurs but that is much less when compared with that of water. Therefore these organic compounds get significantly concentrated by the normal absorptive function of the gallbladder.

Unconjugated bile salts get more easily absorbed in contrast to conjugated bile salts. It happens by bacterial deconjugation of bile salts and in mucosal inflammation. This damages the gallbladder's mucosa which would end up in a nonselective increase in absorption of other solutes, which in turn would impair the solubility of cholesterol and result in stone formation.

C) SECRETION:

The gallbladder secretes two important substances namely mucin glycoproteins and hydrogen ions. The former is thought of as an important pronucleating agent, while the latter acidifies hepatic bile and prevents precipitation of calcium salts. The secretion of mucin glycoproteins is aided by prostaglandins . The mucin layer is considered to protect against damage caused by unconjugated bile salts.

The transport of hydrogen ions across the gall bladder epithelium occurs by means of sodium exchange. This leads to acidification of bile resulting in a pH of 7.1- 7.3, which has an implication in calcium solubility, by preventing precipitation of calcium salts. Comparatively, the hepatic bile is slightly alkaline (pH 7.5-7.8) and its loss culminates in metabolic acidosis.

(D) MOTILITY

During fasting, the sphincter of ampulla is tonically contracted which produces a pressure of 10-15 mmHg in the common bile duct and the gallbladder gets passively filled with bile (11). This does not happen in a continuous fashion though, and is interrupted by short episodes of emptying, which occurs in co-ordination with passage of an MMC

(Migratory motor complex) in the duodenum and the process is mediated by Motilin [12]. During meals however, the sphincter of Oddi relaxes and allows emptying of the gallbladder (50 -70 % of volume) that lasts for 30 -40 minutes, aided by cholecystyokinin. Over the next 60 -90 minutes, the gallbladder refills gradually. Any interruption of this sequence leads to bile stasis which is lithogenic [13].

COMPOSITION OF BILE:

Bile salts form the major component of bile. The other constituents are bilirubin cholesterol, lecithin, and electrolytes. The gallbladder by reabsorbing water and most of the electrolytes (except calcium ions), concentrates bile and so bile from the liver varies entirely when compared to that from the gallbladder.

PATHOLOGY OF GALL BLADDER

CHOLELITHIASIS [GALL STONES]

INCIDENCE: The prevalence of gallstones in India is about 10%, about half of that in the western world (14). The disease is about 3 times more common in women, though the prevalence depends upon various risk factors.

RISK FACTORS (15)

NONMODIFIABLE

- Female gender.
- Increasing age.
- Genetic factors: ethnicity (Pima tribes of south Arizona, American Indians), family (16)

MODIFIABLE

- Hypertriglyceridaemia.
- Cholesterol lowering agents
- multiparity
- Ileal resection (17)
- Gallbladder stasis (*Hyperalimentation*Total parenteral nutrition, fasting)
- Diet (high calories, low fibre, low calcium and vitamin C)
- Alcohol abstinence
- Smoking
- Sedentary behaviour

PATHOGENESIS OF CHOLESTEROL STONES:

The stages involved are

- Cholesterol supersaturation of bile.
- Nucleation
- Growth of stone.

i- CHOLESTEROL SATURATION:

THE CONCEPT OF MICELLES: The nonpolar cholesterol is kept in solution by the formation of micelles, the bile salt–phospholipid-cholesterol complex. In aqueous solutions, bile salts are oriented with the hydrophilic portion outward. The phospholipids that are incorporated into the micelle structure, allows cholesterol to be added to the hydrophobic central part. When the micelles are saturated with cholesterol, the excess comes out of solution and precipitates as crystals [18, 19].

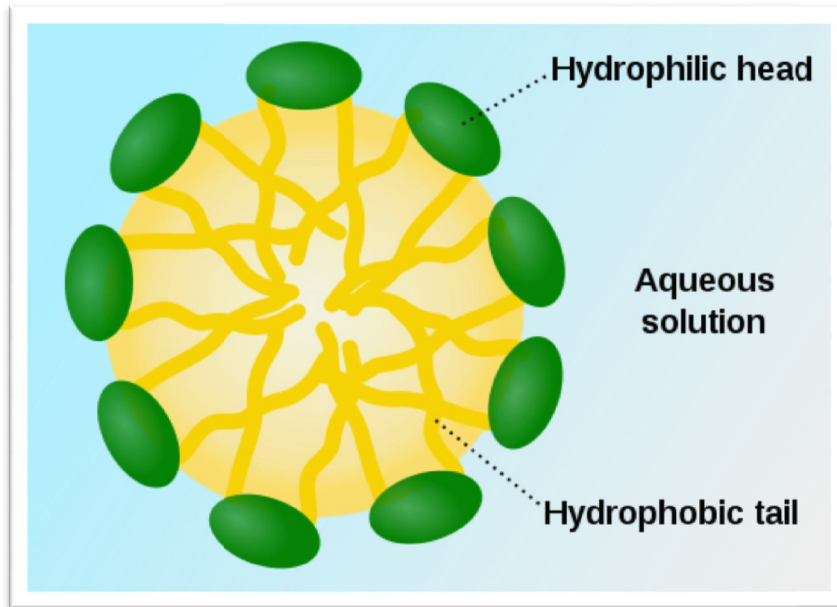


Figure 11. Structure of a Micelle

The key to maintaining cholesterol in solution is by the formation of micelles, a bile salt–phospholipid-cholesterol complex, and cholesterol-phospholipid vesicles. During excess cholesterol production, the capacity of these vesicles as well as the micelles is exceeded and crystal precipitation occurs. Due to the fact that cholesterol crystal precipitation occurs preferentially by vesicular rather than micellar mechanisms, the ultimate effect of concentrating bile is an increased tendency to nucleate cholesterol [20].

By plotting the percentages of each component on triangular coordinates, the micellar zone in which cholesterol is completely soluble can be demonstrated. In the area above the curve, bile is supersaturated

with cholesterol, and precipitation of cholesterol crystals occurs [18, 19].

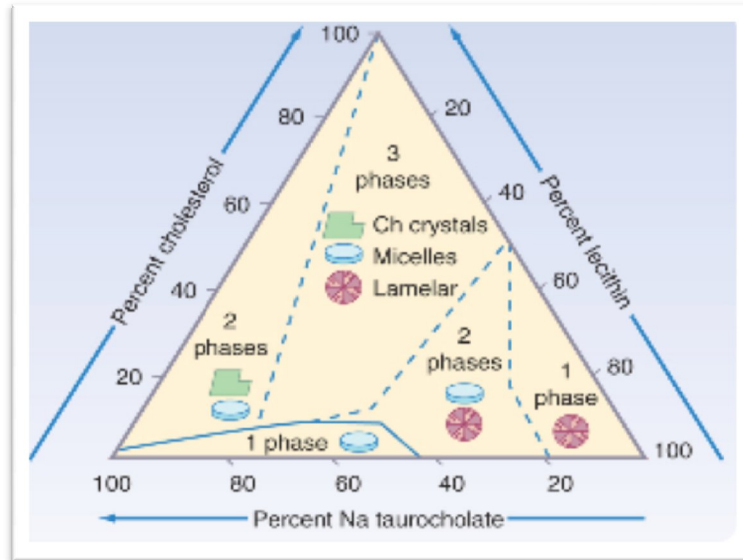


Figure 12 Triangular phase diagram showing cut off point of cholesterol crystal precipitation

The second step is accelerated nucleation or the rapid transition from liquid to crystal, which occurs when there are excess nucleation factors or absence of nucleation inhibitors. It is the process by which cholesterol monohydrate crystals form and aggregate to become macroscopic.

Mucin glycoproteins act as pronucleating agents for cholesterol crystallization. Many heat labile glycoproteins in the bile of gallstone

patients have been identified as potential pronucleating factors.

Gallbladder mucus is the matrix on which cholesterol crystals aggregate.

The third step is the growth of the stone.

Besides gallbladder hypomotility, altered prostaglandin metabolism also plays its role in the genesis of gallstone.

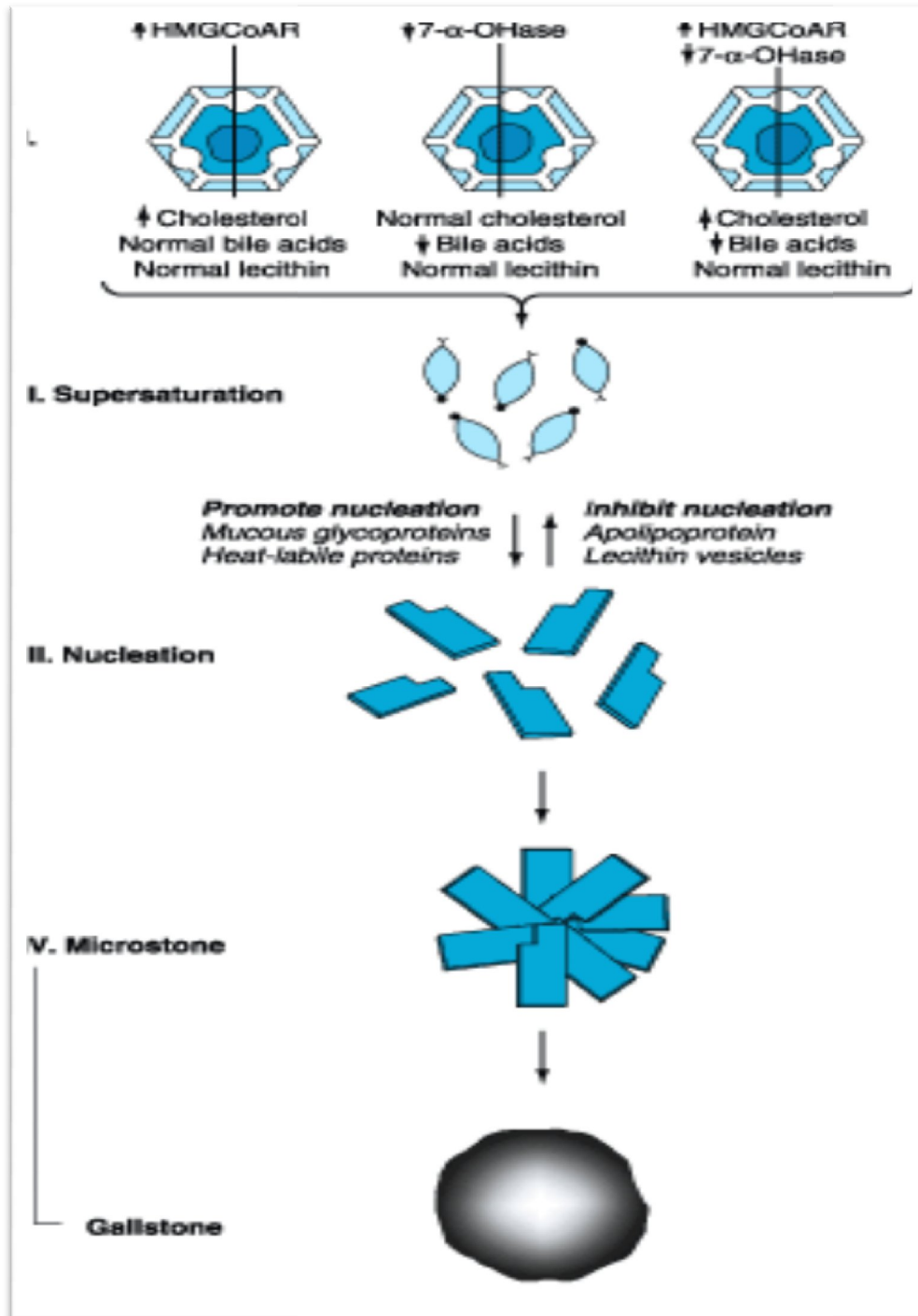


Figure 13. The process of cholesterol stone formation

PATHOGENESIS OF PIGMENT STONES:

Pigment stones contain <20% cholesterol and are dark due to the presence of calcium bilirubinate.

Black pigment stones are formed by supersaturation of calcium bilirubinate, carbonate, and phosphate, mostly secondary to hemolytic disorders like hereditary spherocytosis and sickle cell disease, and in those with cirrhosis. They are usually small, brittle and black.

Brown pigment stones are secondary to bacterial infection, Beta-glucuronidase in E.coli enzymatically cleaves bilirubin glucuronide to produce the insoluble unconjugated bilirubin, which precipitates with calcium, and along with dead bacterial cell bodies, forms soft brown stones.

GALLSTONES IN THE NON-OBESE:

Non-obese patients have a diminished expression of apical sodium-dependent bile acid transporter (ASBT) in terminal ileum.

Also in Crohn's ileitis, there's a significant downregulation of this transporter (21).

NATURAL HISTORY:

Most gallstones are asymptomatic. Only 1% to 2% of patients ultimately need intervention, either surgical or endoscopic. The spectrum of symptomatic cholelithiasis ranges widely from biliary colic to acute and chronic complications. On an average, asymptomatic individuals develop symptoms at the rate of 3% per year. Once symptomatic, episodes of biliary colic keep recurring. Out of those that recur, the incidence of complications is 3-5% per year. Roughly two thirds of asymptomatic patients with gallstones remain so over 20 years. Generally mildly symptomatic patients go for cholecystectomy due to severe symptoms at the rate of 6% to 8% per year in the early years and gradually decreasing with longer follow-up (22,23).

CLINICAL MANIFESTATIONS

GALL BLADDER DYSPEPSIA

The constellation of symptoms like belching, burping, heartburn and epigastric discomfort experienced after a fatty meal constitutes 'dyspepsia', which classically occurs in gallstone disease.

ACUTE CHOLECYSTITIS

When the gallstone obstructs the cystic duct by a gallstone, a series of events initiated by the mucosal lyses of lecithin follow, that is distention of the gallbladder, inflammation and edema of the wall, which when superimposed with bacterial infection causes haemorrhage and necrosis of the gallbladder wall with pericholecystic fluid collection. In the severe form which occurs in 5-10 % of cases, ischemia and necrosis of the wall occurs (*Gangrenous cholecystitis*) and in cases of infection with gas forming organisms, an emphysematous gallbladder results. Sometimes with unresolving sepsis, the gallbladder may perforate secondary to an *emphyema*, which is sometimes contained by the omentum or may end up in intraperitoneal abscess or a *cholecystoenteric fistula* occur.

Rarely a cystic duct stone can obstruct the common bile duct due to the surrounding severe inflammation (*Mirizzi's syndrome*).

The timing of cholecystectomy in case of acute cholecystitis is a matter of debate. A prospective randomized controlled trial by Lai Ec et al in 1998 compared the results of early (within 72 hours of admission) and delayed cholecystectomy and showed no significant differences in morbidity or mortality, although the delayed group ended up in a

significantly prolonged hospital stay (11 vs. 6 days) and recovery period (19 vs. 12 days) [24, 25, 27].

BILIARY PANCREATITIS

Gallstones which are less than 5 mm in size and multiple stones have the risk of causing acute pancreatitis [26]. Stone impaction at the ampulla leads to blockage of pancreatic secretions and results in pancreatitis. A severe form of biliary pancreatitis needs an ERCP (Endoscopic retrograde cholangiopancreatography) and sphincterotomy, followed by cholecystectomy once the severity subsides. These patients must have an intraoperative cholangiogram

INVESTIGATIONS OF GALLSTONE DISEASE

BLOOD INVESTIGATIONS

In evaluating a case of suspected cholelithiasis, a complete hemogram and liver function tests are routinely done. An increase in the total white blood cell (WBC) count is suggestive of cholecystitis and if an elevated total bilirubin, alkaline phosphatase, and aminotransferase are found, one should think in terms of cholangitis. Increased total bilirubin and serum alkaline phosphatase go in favour of cholestasis.

SONOLOGY IN GALLBLADDER DISEASE: It is a proven fact that ultrasonogram is the initial investigation of choice in evaluating gallstone disease. Ultrasonogram identifies stones as small as 2mm with a sensitivity of 95%. Although it is operator- dependent, the ease of availability and cost effectiveness makes it the ideal investigation. Stones are detected by their post acoustic shadow. Calcified polyps are differentiated from stones by the fact that the former is static while the latter has postural variation of location. Besides establishing the diagnosis, it is also a useful tool to predict the amount of difficulty involved in laparoscopic cholecystectomy [28, 29]

The factors that have been found to significantly influence the outcome by Jansen et al in 1997 were large stones (2cm), a thick walled gallbladder (>0.4cm) , a dilated common bile duct (> 0.6cm) on ultrasound. The number of stones in the gallbladder did not seem significant [58]. With a gall bladder wall thickness of > 0.4cm, surgery would be technically demanding, as it would be difficult to grasp. A preoperative ultrasound also helps to identify wall calcifications which might pose difficulty in grasping and retraction during laparoscopic cholecystectomy [30,31].

ORAL CHOLECYSTOGRAPHY

Ever since its introduction in 1924 by Graham and Cole, it continued to be the primary investigatory modality until replaced by ultrasonography. Stones are identified by the presence of filling defects in the visualised gallbladder. This is not useful in patients with obstructive jaundice, liver cell failure and intestinal malabsorption.

BILIARY SCINTIGRAPHY (HIDA SCAN):

It is a noninvasive investigation which delineates both anatomy and function of the biliary tree. ^{99m}Techetium-labeled hepatic iminodiacetic acid (HIDA) is given intravenously. The reticuloendothelial cells clear the liver off the contrast and excrete the same through bile which is detected by gamma camera. The uptake detected at 10 minutes images the liver and the one detected over 60 minutes images the rest of the biliary tree [32]. Its prime usage is in diagnosing acalculous cholecystitis (biliary dyskinesia) wherein the gallbladder is not visualised in contrast to the readily apparent common bile duct and duodenum. False-positive results are obtained in conditions of gallbladder stasis (critically ill patients, patients on total parenteral nutrition).

COMPUTED TOMOGRAPHY (CT):

CT scan of the abdomen is considered inferior to ultrasonography for the diagnosis of gallstones and it's mainly used to define and delineate extrahepatic biliary tree and other adjacent structures. .

MAGNETIC RESONANCE IMAGING (MRI)

MRI and MRCP (Magnetic resonance cholangiopancreatography) are the ultimate choices when it comes evaluating biliary tract disease. This is required when the presence of common bile duct (CBD) stones are suspected, as in cases with a dilated CBD and dilatation of the intrahepatic biliary radicals [33].MRCP identifies bile ducts as high-signal-intensity structures in heavily T2-weighted sequences and recently pulse sequences have been defined so as to generate high resolution images.

COMPLICATIONS OF GALLSTONES [34, 35]

- Acute and chronic cholecystitis
- Emphysematous cholecystitis
- Empyema gallbladder
- Gallbladder perforation
- Biliary pancreatitis

- Cholangitis
- Mirizzi's syndrome
- Gallstone ileus
- Cholecysto-enteric fistula
- Gastric outlet obstruction (Bouveret's syndrome)
- Carcinoma gallbladder with stones > 3cm size and calcified gallbladder

MANAGEMENT OF GALLSTONES- NONOPERATIVE

Nonoperative Therapies for Symptomatic Gallstones

<i>AGENT</i>	<i>ADVANTAGES</i>	<i>DISADVANTAGES</i>
Oral bile acid dissolution: ursodeoxycholic acid (Actigall), at 8 to 10 mg per kg per day	Stone clearance: 30 to 90 percent with zero percent mortality	50 percent recurrence of stones; dissolves noncalcified cholesterol stones; optimal for stones < 5 mm; symptom relief does not start for 3 to 6 weeks; may take 6 to 24 months for results

<i>AGENT</i>	<i>ADVANTAGES</i>	<i>DISADVANTAGES</i>
Contact solvents: methyl <i>tert</i> -butyl ether/ <i>n</i> -propyl acetate	Stone clearance: 50 to 90 percent	70 percent recurrence of stones; experimental, with insufficient data; duodenitis; hemolysis; nephrotoxicity; mild sedation
Extracorporeal shock-wave lithotripsy: electrohydraulic/electromagnetic	Stone clearance: 70 to 90 percent with < 0.1 percent mortality	70 percent recurrence; not approved by FDA; performed only at centers with expertise; selection criteria require no more than one radiolucent stone (< 20 mm in diameter), patent cystic duct, functioning gallbladder in a patient with symptomatic gallstones without complications

FDA = U.S. Food and Drug Administration.

Ref: AIJAZ AHMED, M.D., RAMSEY C. CHEUNG, M.D., and EMMET B. KEEFFE, M.D., Management of Gallstones and Their Complications Am Fam Physician. 2000 Mar 15;61(6):1673-1680.

OPERATIVE MANAGEMENT OF GALLSTONES:

CHOLECYSTECTOMY – ANATOMIC CONSIDERATIONS:

The success of any surgery lies upon the adequacy and accuracy of anatomical knowledge and this holds true here as well. Iatrogenic injuries most often occur due to unidentified anomalies.

One has to identify the Calot's and the Moosman's triangles, ensure the identity of the structures passing through, before intervening. An aberrant right hepatic artery arising from the superior mesenteric artery can course through the medial aspect of the Calot's triangle, with cystic duct lying anterior to it. Accessory hepatic ducts may also traverse the Calot's triangle. Hence adequate visualisation of the anatomy is of paramount importance in any form of cholecystectomy. The origin of the cystic artery, the junction of cystic duct with common hepatic duct may be anomalous many a time and should be looked for. An intra-operative cholangiogram can be helpful in difficult situations.

Indications and Relative Indications for an Open Cholecystectomy

Severe cholecystitis (relative)

Inability to delineate anatomy during laparoscopic cholecystectomy

Emphysematous gallbladder (relative)

Suspicion for gallbladder cancer

Perforation of gallbladder/abscess

Fistulization of gallbladder gallstone ileus (relative)

Cholangitis (relative)

Multiple past abdominal procedures (relative)

Pregnancy (relative)

Cirrhosis/portal hypertension (relative)

Blood dyscrasias (relative)

Contraindication for laparoscopy

Relative Indications for Prophylactic Cholecystectomy

Cardiac transplant recipients

Lung transplant recipients

Chronic total parenteral nutrition requirement

Recipients of biliopancreatic diversion (bariatric patients)

Family history of gallbladder cancer and asymptomatic stones

Children with hemoglobinopathy (sickle cell, thalassemia, spherocytosis)

Cholelithiasis encountered during elective abdominal procedures

INDICATIONS FOR LAPAROSCOPIC CHOLECYSTECTOMY:

A) Symptomatic gallstones

- Biliary colic
- Acute cholecystitis
- Chronic cholecystitis
- Gallstone pancreatitis

B) Asymptomatic Gallstones

- Total parenteral nutrition
- Sickle cell anemia
- Chronic immunosuppression
- Lack of immediate access to tertiary care
(military personnel, relief workers)
- Biliary dyskinesia
- Polyp > 10mm
- Porcelain gall bladder

CONTRAINDICATIONS TOLAPAROSCOPIC

CHOLECYSTECTOMY:

A) ABSOLUTE:

- Contraindication to general anaesthesia
- Bleeding disorder
- Gallbladder malignancy in doubt

B) RELATIVE

- Morbid obesity
- Peritonitis
- Cholangitis
- Chronic obstructive lung disease
- Liver cirrhosis
- Pregnancy
- History of upper abdominal surgery

LAPAROSCOPIC CHOLECYSTECTOMY

OPERATING ROOM SET-UP

Two techniques have been described, the American and the French technique. The Americans advocate the surgeon to approach

from the patient's left side and the first assistant to be on the patient's right side.

The French technique is the one in which the surgeon stands in between the patient's abducted legs.

PNEUMOPERITONEUM

This again could be achieved by either the closed or the open Hasson's technique. CO₂, the non-combustible gas is quite safe, though there are reported incidences of hypercarbia secondary to cardiopulmonary disease.

PORT PLACEMENT AND EXPOSURE

In the conventional technique, two 5mm and two 10mm ports are used. The 10 mm ports are made, one each in the umbilical and epigastric regions, and the 5mm ports are made in the right subcostal region, one each in anterior axillary line and midclavicular line.

PROCEDURE

With a cephalad traction at the fundus and a lateral traction at the infundibulum, Calot's triangle comes into view and one has to stay parallel to cystic duct. Once the cystic duct and artery are identified and

skeletonised, it would be ideal to visualise the Rouviere's sulcus and dissection should not proceed any further. After clearing the structures in the Calot's triangle, the Strasberg's Critical View of Safety is identified to prevent bile duct injury.

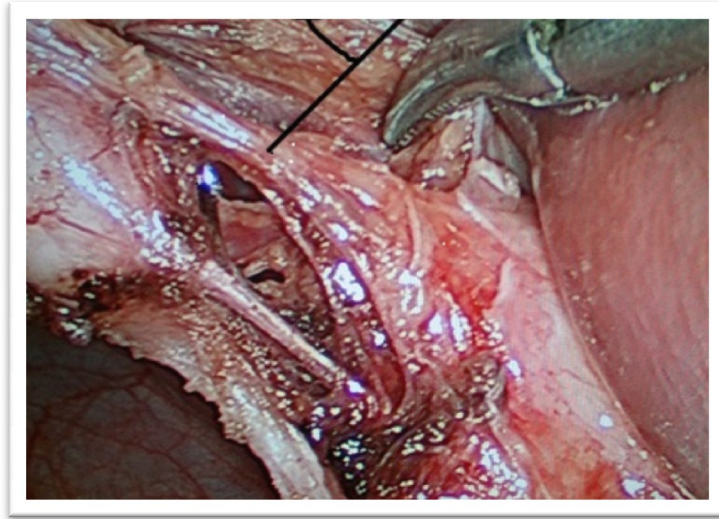


Figure 14 A View of Calot's Triangle

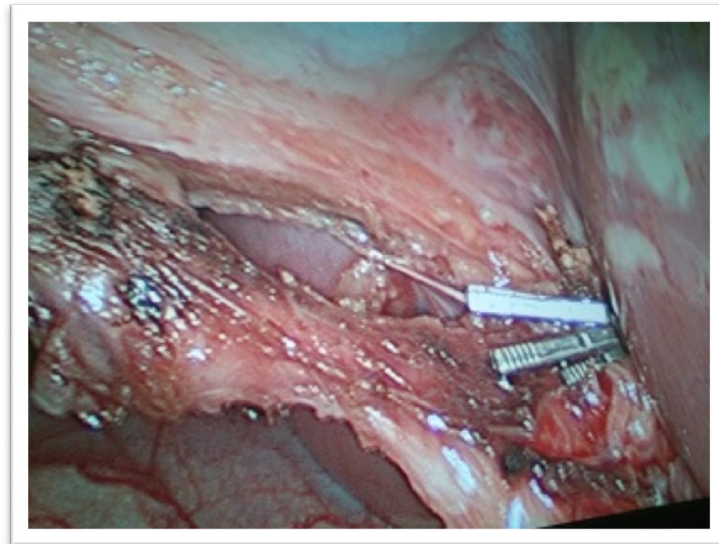


Figure 15 Strasberg's Critical View Of Safety

Clips are applied over the cystic artery and duct. Essentially the artery should be divided first for two reasons : 1- division of the artery results in lengthening of the cystic duct by a few mm which can be safely divided, 2- if bleeding occurs, one might mistake common bile duct for cystic duct while clamping. Gallbladder is dissected off the liver bed and hemostasis ensured. Following port closure, analgesic infiltration is given at the port sites for postoperative pain relief.

INTRAOPERATIVE GALLBLADDER PERFORATION

Perforation of the gallbladder occurs due to excessive traction or by electrocautery and can lead to spillage of bile and stones. The spilled stones if contain cholesterol predominantly carry little risk of infection which is not true with pigment stones [36].

Studies have shown no significant increase in morbidity with spillage of stones, except for an increased operating time.

LAPAROSCOPIC APPROACH- THE SAFETY CHECKLIST:

1. Optimal visualisation- 30 degree scope
2. Clear view of Calot's triangle and cystic duct – Gallbladder junction
3. Lateral retraction of infundibulum and cranial retraction of fundus

4. To establish Strasberg's Critical view
5. To minimise electrocautery dissection close to Common bile duct
6. To visualise cystic duct before clip application.

COMPLICATIONS OF LAPAROSCOPIC

CHOLECYSTECTOMY:

Intra operative

i) Related to pneumoperitoneum

- CO2 embolism
- Vasovagal reflex
- Cardiac arrhythmia
- Hypercarbic acidosis

ii) Trocar related

- Bowel injury
- Vascular injury

iii) Dissection related

- Injury to cystic artery
- Injury to bile duct
- Retained stones
- Bile leakage

Post operative

- Wound infection
- Bile leak
- Basal atelectasis
- Incisional hernia

**COMPARISON OF VARIOUS SERIES OF LAPAROSCOPIC
CHOLECYSTECTOMY:**

SERIES	YEAR	CONVERSION RATE %	BILE DUCT INJURIES %
Cushieri, et al	1991	2.6	0.3
Scott, et al	1992	4.3	0.4
Litwin, et al	1992	4.3	0.1
Orlando, et al,	1993	6.9	0.3
Fullarton, et al	1994	17	0.7
Brune, et al	1994	1.2	0.2

**PROSPECTIVE TRIALS COMPARING LAP VS OPEN
CHOLECYSTECTOMY**

Series	Year	Complications (%)	Duration of hospitalisation (days)	Time taken to return to duty (days)
Barkun, et al,	1992			
OC		8.0	4*	20*
LC		2.7	3	12
Trondsen, et al	1993			
OC		20	4*	34*
LC		17	3	11
Berggren, et al	1994			
OC		—	3*	24*
LC		—	2	12
Kiviliuto, et al	1998			
OC		23*	6*	30
LC		3	4	14

LAPAROSCOPIC VS OPEN APPROACH- COMPARED AND CONTRASTED:

Laparoscopic cholecystectomy (LC) has its own merits and demerits. Though the rate of complications were much higher than open surgery during the early periods after its introduction, say in the 1990's, as reported by Fletcher et al in 1999 of an increase in the intraoperative complication from 0.67% to 1.33% [34]. But recent evidence states that LC entails lower morbidity and mortality rates than open operation. The morbidity rate for an open cholecystectomy ranges from 5% to 20% as compared to 1.5-8.6% with laparoscopic cholecystectomy. Jatzko et al in a multivariate analysis came out with a report of 7.7% morbidity rate from open surgery as compared to 1.9% for LC and 5% mortality rate vs 1% for LC [37, 38, 39]. But the same is not applicable for bile duct injuries as is evident from various studies. Roslyn et al had shown an incidence of 0.2% bile duct injuries [35] from 42,000 open cases as against 0.4-1.3% from laparoscopic cholecystectomies

ADVANTAGES OF LAPAROSCOPIC CHOLECYSTECTOMY:

<ul style="list-style-type: none">• Better cosmesis• Less pain
<ul style="list-style-type: none">• Decreased length of hospital stay
<ul style="list-style-type: none">• Earlier return to work
<ul style="list-style-type: none">• Less overall cost

DISADVANTAGES

Lack of depth perception
Decreased tactile discrimination
Bleeding difficult to control
View control lies in hands of camera operator
Complications of pneumoperitoneum

Despite the positive trend in the number of surgeries performed and the favourable outcomes, open surgery or an early conversion to open is the choice when it comes to complicated cases. In patients presenting with minimal symptoms, the chances of a difficult outcome needs to be predicted as the complications, if occur are difficult to manage. This indeed would enable a beginner to approach the cases with more confidence and also lessen the avoidable morbidity to the patient.

WHAT'S NEW?

OUT PATIENT LAPAROSCOPIC CHOLECYSTECTOMY:

The concept of Out Patient laparoscopic cholecystectomy (LC) has been in practise for about a decade. Bueno et al in 2006, shared his experience from 504 cases of outpatient LC and reported an ambulatory percentage of 88.8% with a mean hospital stay of 6.1 hours. The complication rate was 11.6% and 10.1% of them required overnight stay [40].

Inspite of promising results, the acceptance rate remains low and the potential barriers evaluated are found to be medical and institutional, with medical barriers being patient comorbidities. Forrest et al in 2001 formulated a consensus protocol incorporating comprehensive health education and a multidisciplinary approach to overcome such barriers [41] which promoted a significant increase in the acceptance rate from 21% to 72%

Voyles et al formulated selection criteria to ensure safety of the procedure which included age less than 65, absence of upper abdominal operations, and elective operations in healthy patients at low risk for

common bile duct stones. Therefore with a careful patient selection and adequate surgical expertise, LC can be a safe outpatient surgery [42].

MINILAP

Mini port laparoscopic surgery was another step towards improved cosmesis. It involves the use of 10-mm umbilical, 5-mm epigastric, 2-mm subcostal, and 2-mm lateral ports. The results of Novitsky et al showed decreased early postoperative incisional pain, late incisional discomfort and superior cosmetic results, though not statistically significant [43,44].

SILS

Yet another less invasive surgical procedure in the era of minimal access surgery is SILS. Using a single 12mm incision at the umbilicus and a 5mm trocar introduced through the same, peritoneal cavity is viewed with a 5mm, 30degree optic. The 2nd and 3rd trocars are introduced to the left and right of the 5 mm trocar. With two sutures to suspend GB, Calot's triangle evaluated and dissection performed using endoshear roticulator on the left and an endograsp roticulator on the right. Tacchino et al in 2009 reported a decrease in operating time from an initial 3 hours to 50 min after the first five cases in his series of 12

cases [45]. A recent study states that the improved cosmesis associated with SILS happens so at the cost of increased port site hernia rates of 8.4% as compared to 4% with conventional LC (Marks et al , 2013). Yet cosmesis scores continue to favour SILS [45].

NOTES

Portugal et al used transgastric and transvesical approach to cholecystectomy. The first series of transvaginal NOTES cholecystectomy was performed by a Research Group led by Ricardo Zorron in March 2007. Since it involves the use of flexible endoscopes that result in partial loss of spatial orientation and depth perception, there has been focus on getting computer assisted images [46, 47].

PREOPERATIVE PREDICTION –THE NEED OF THE HOUR

Laparoscopic Cholecystectomy is the treatment of choice for symptomatic cholelithiasis. It is also associated with the worst of complications, which, when encountered cripples the patient as well as the surgeon. It would be extremely useful to have a method by which significant risk factors could be analysed preoperatively and to identify patients at potential risk of developing complications.

By identifying parameters that would predict conversion, better perioperative planning, patient counselling, optimum operating room efficiency and risk stratification could be achieved and patient safety ensured. It helps in guiding a surgeon intraoperatively in decision making and the need for early conversion. Data suggest a 4 fold increase in the risk of complications when the duration of surgery exceeds 2 hours [37].

Risk stratification determines the duration of trial dissection, with an inclination to convert if no progress is noted during dissection of the Calot's triangle over half an hour for those at high risk. For low risk patients, this could be extended to 1 hour and if there seems a possibility of dissection, one can proceed with the surgery.

PARAMETERS THAT PREDICT A DIFFICULT LC

Various studies have been conducted worldwide to identify the set of factors that have an implication on the conversion rates. They include clinical, biochemical and sonological parameters and their influence has been validated in both elective and emergency settings [48-51].

Many clinical parameters have been studied including, age, gender, obesity, addictive habits, comorbidities like chronic obstructive pulmonary disease, diabetes mellitus, liver cirrhosis, history of previous abdominal surgery, signs of acute cholecystitis like right hypochondrial tenderness or a palpable gall bladder. Also the preoperative ASA (American Society of Anaesthesiologists) classification, the timing of surgery, whether in an elective or emergency setting has been analysed [48].

Many studies support the influence of biochemical parameters like hyperbilirubinemia, hypoalbuminemia and leucocytosis on the outcome.

The sonological features that should warn the surgeon preoperatively include presence of fluid around gallbladder, thickened wall, stone impaction at the neck and a dilated common bile duct [57, 58].

There have been attempts to developing a scoring system which would help in risk stratification of patients. Yet there's no system which has been found significant and widely accepted.

Our study being conducted at an elective setting did not include laboratory criteria.

AIMS AND OBJECTIVES OF THE STUDY:

- To determine the possibility of predicting preoperatively a difficult laparoscopic cholecystectomy
- To determine the factors which significantly predict the outcome
- To identify patients at risk in an elective setting and thereby enable patient counselling.

MATERIALS AND METHODS:

PLACE OF STUDY: Department Of General Surgery, Stanley Medical College, Chennai.

PERIOD OF STUDY: JANUARY – NOVEMBER 2013.

STUDY DESIGN: PROSPECTIVE ANALYTICAL STUDY

The study was approved by the Ethical Committee, Stanley Medical College.

INCLUSION CRITERIA:

- All cases of symptomatic uncomplicated cholelithiasis

EXCLUSION CRITERIA:

- Patient not willing for laparoscopic cholecystectomy
- Patient who are not fit for laparoscopic surgery. Eg. Severe COPD
- Patient with acute cholecystitis, gall stone pancreatitis, empyema gall bladder

- Patients with coexisting Common Bile Duct stones and dilated common bile duct, requiring procedures additional to cholecystectomy.
- Cases requiring conversion due to technical failure.

METHODOLOGY:

Patients with symptoms suggestive of cholelithiasis were subjected to complete clinical, biochemical and radiological investigations. 40 patients who met the inclusion criteria and planned for elective surgery and operated upon by a single experienced laparoscopic surgeon were studied after getting their consent.

After complete clinical and radiological evaluation, 9 characteristics were analysed and patients were assigned scores based on their history, clinical examination and sonological findings (Table 1) one-day prior to surgery. Score upto 5 was designated as easy, 6–10 as difficult and 11–15 as very difficult. The outcome was defined based on prefixed criteria as per Table 2.

Surgery was done using CO₂ pneumoperitoneum with 12mm Hg pressure and using standard two 5 mm and two 10 mm ports. The timing was noted from incision for the first port until the closure of the last

port. The intraoperative events were recorded. All cases received standard postoperative care and follow up.

Statistical analysis was done using Chi-square test and Fischer's exact t test for analysing the significance of the variables and Microsoft excel for tabulation.

TABLE 1-Scoring Methodology

Age	Scoring Pattern
Less than 50	0
Above 50	1
Gender	
Female	0
Male	1
Previous Hospitalization	
Yes	4
No	0
Body Mass Index	
Up to 25	0

25 to 27.5	1
Above 27.5	2
Abdominal Scar	
No	0
Infraumbilical scar	1
Supraumbilical Scar	2
Palpable GB	
Yes	1
No	0
Wall Thickness	
Yes	1
No	0
Impacted Stone	
Yes	1
No	0
TOTAL SCORE	15
Outcome	
EASY	Less than 5
DIFFICULT	6 to 10
VERY DIFFICULT	Above 10

TABLE 2

OUTCOME	CRITERIA
EASY	TIME<60 MINUTES NO BILE/STONE SPILLAGE NO DUCT/ARTERIAL INJURY
DIFFICULT	TIME 60-120 MINUTES BILE/STONE SPILLAGE
VERY DIFFICULT	TIME>120 MINUTES DUCT/ ARTERIAL INJURY CONVERSION

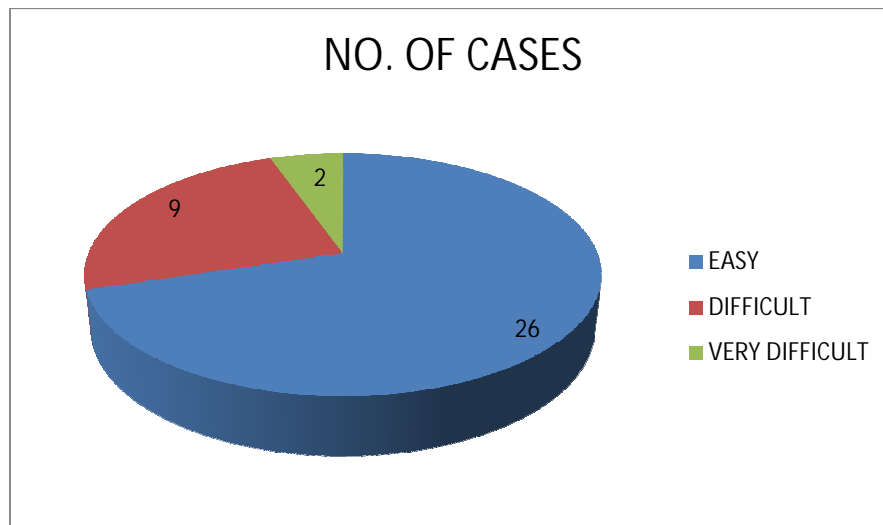
OBSERVATION AND RESULTS:

From a total no.of 40 patients who met the inclusion criteria, the following analysis was made.

TABLE 3: PATTERN OF OUTCOME

Outcome	Numbers	Percentage
No. of Easy Cases	26	72.5
No. of Difficult Cases	9	22.5
No. of Very Difficult Cases	2	5.0

FIGURE1: PATTERN OF OUTCOME



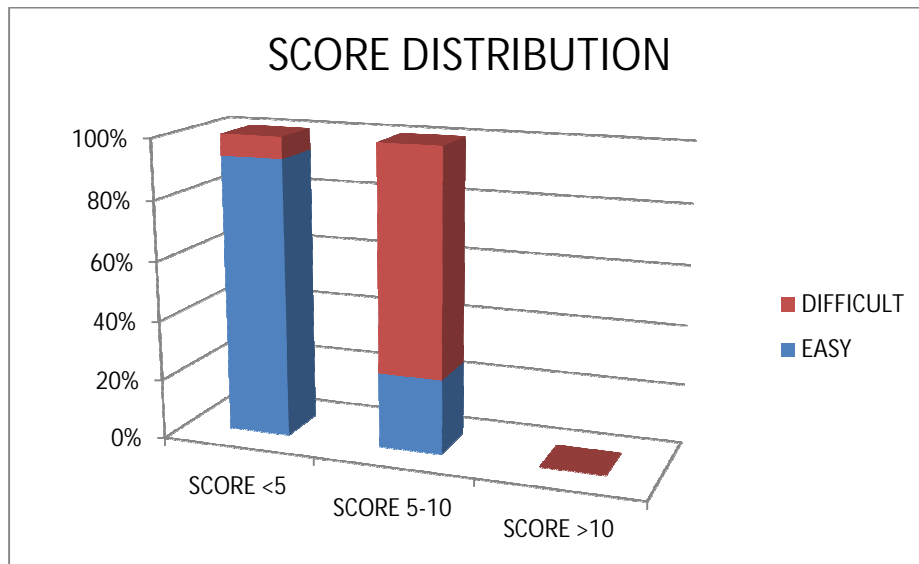
Out of the 40 cases, 9 turned out to be difficult and 2 were very difficult.

TABLE4

Scoring Pattern	Numbers	Percentage
No. of Cases with Score < 5	28	70.0
No. of Cases with Score 5-10	12	30.0
No. of Cases with Score >10	0	0.0

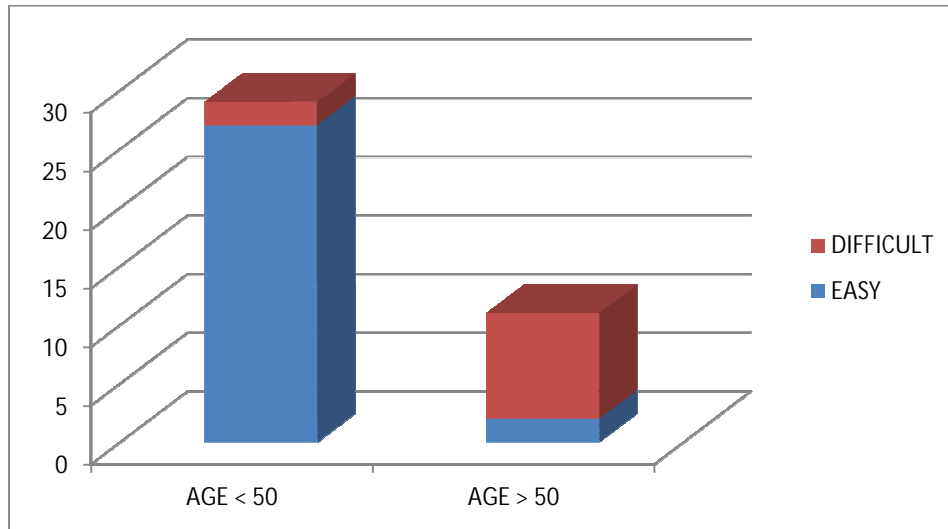
With the aforementioned scoring applied to the cases, 30% of them had a score of 5-10 and none of them met with a score greater than 10 including the very difficult cases.

FIGURE2: SCORE DISTRIBUTION



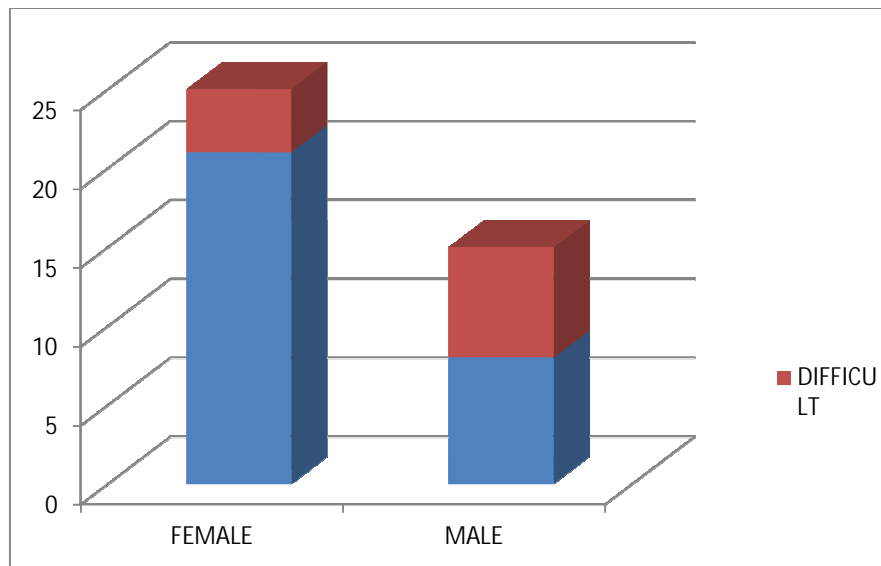
81.8% of difficult cases had a score of 5-10 and none of them had scored greater than 10.

FIGURE 3: AGE AND OUTCOME



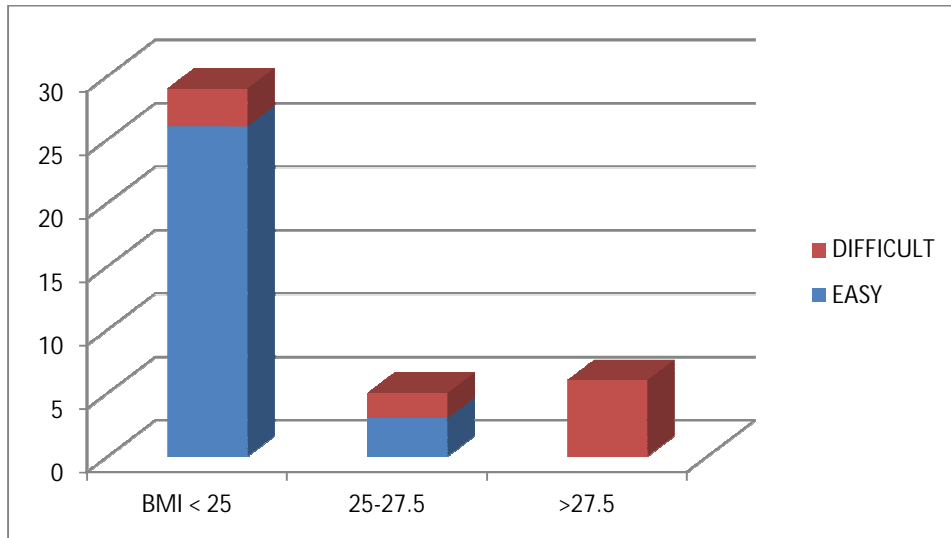
9 patients with age > 50 and 2 patients with age <50 had a difficult outcome and it was a significant factor with p value 0.000.

FIGURE 4. GENDER AND OUTCOME



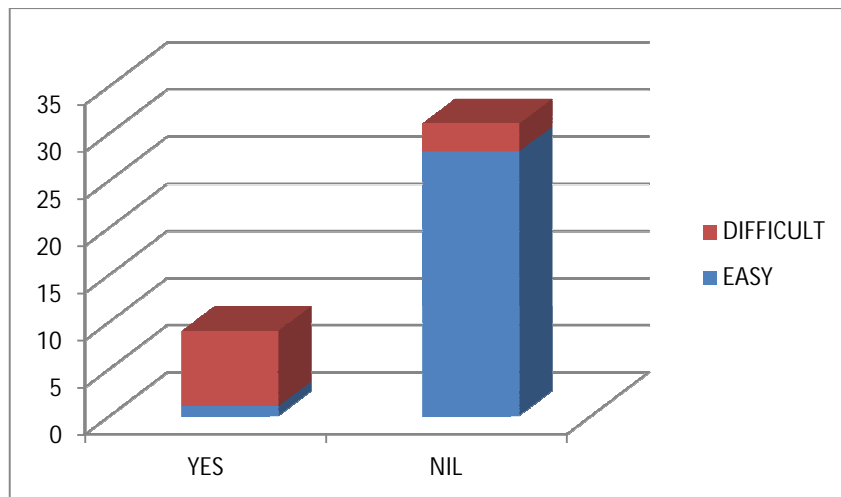
6 out of 13 males and 5 out of 27 females had a difficult outcome and this was not found to be significant (p 0.055)

FIGURE 5. BMI AND OUTCOME



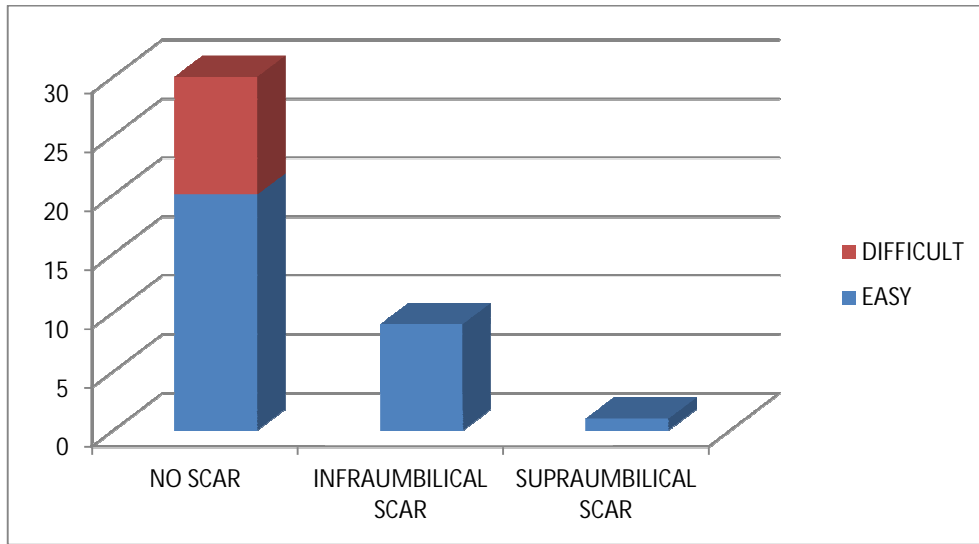
8 out of 11 obese patients had a difficult outcome and obesity was found to be a strongly significant factor (p 0.000).

FIGURE 6. H/O HOSPITALISATION AND OUTCOME



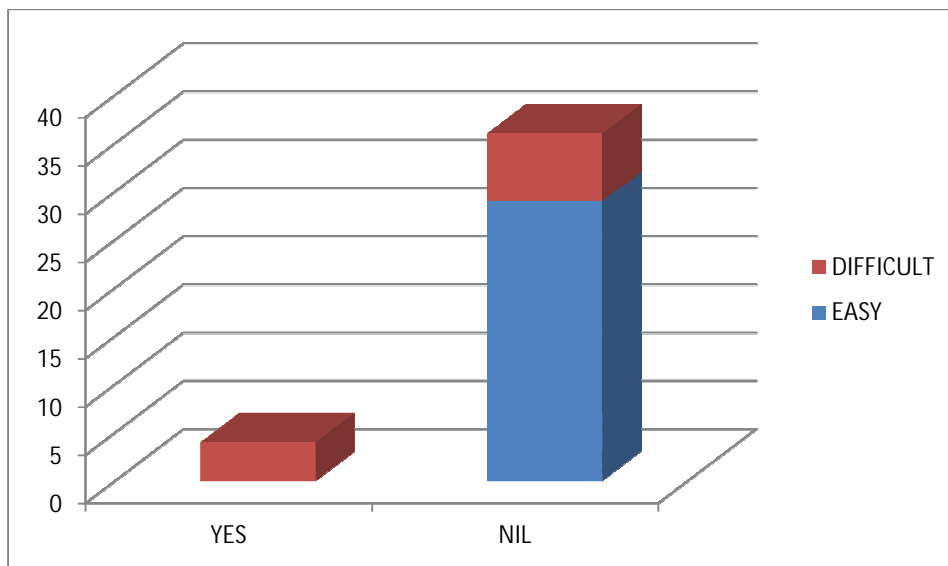
9 out of 11 patients with history of hospitalisation had difficulty and this factor was found to be strongly significant as well (p 0.000)

FIGURE 7. ABDOMINAL SCAR AND OUTCOME



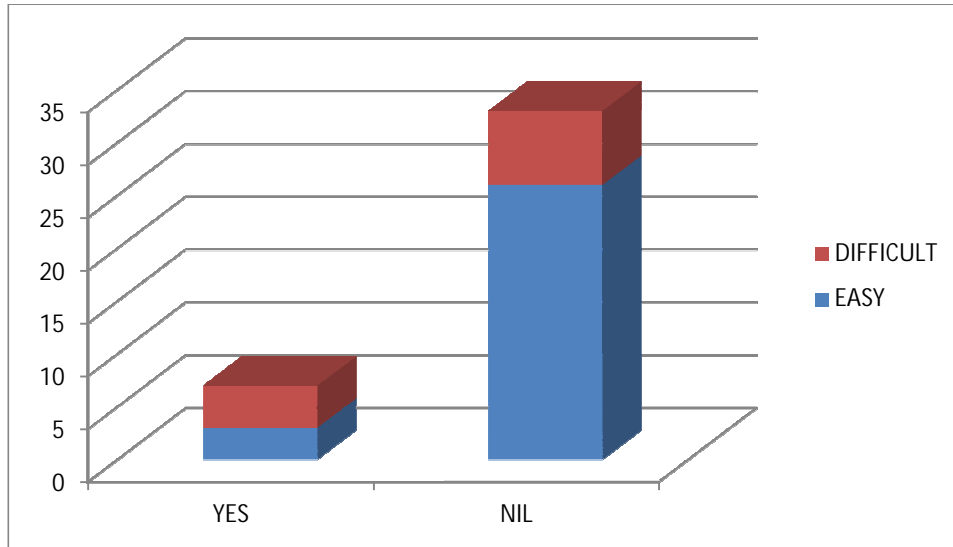
9 out of 11 difficult cases did not have an abdominal scar. Even with supra umbilical scar one case had an easy outcome and this factor was not found to be significant (p 0.058).

FIGURE 8. PALPABLE GALLBLADDER AND OUTCOME



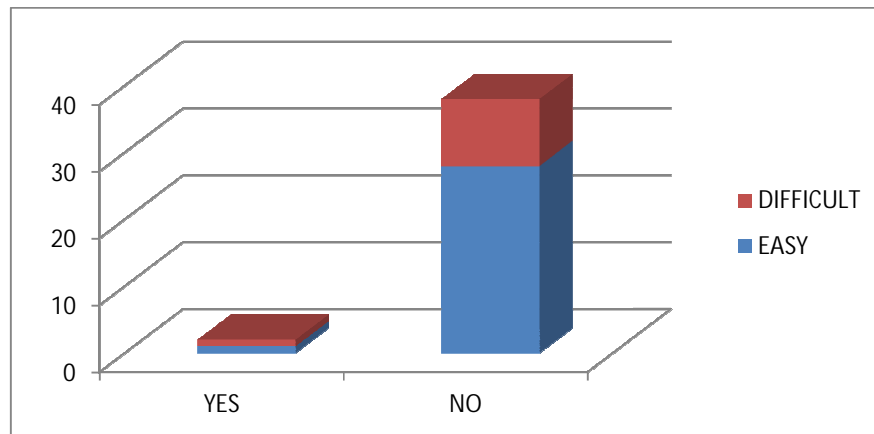
All 4 patients who presented with a palpable gallbladder had a difficult outcome and this factor was found significant (p 0.001).

FIGURE 9. THICKENED GALLBLADDER AND OUTCOME



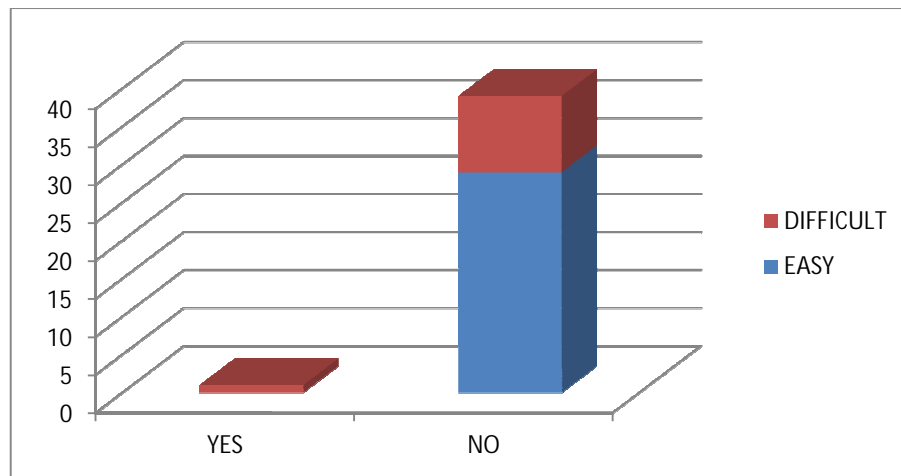
4 out of 7 patients with a thickened gallbladder had a difficult outcome and this factor too was found significant (p. 0.050)

FIGURE10. PERICHOLECYSTIC FLUID COLLECTION AND OUTCOME



Only two patients presented with pericholecystic fluid collection, 10 difficult cases out of 11 did not have pericholecystic fluid and this factor was not found significant (p 0.464)

FIGURE11. IMPACTED STONE AND OUTCOME



Only one patient presented with impacted stone and his was a difficult case. 10 out of 11 cases did not have impacted stones and this factor was not found significant (p 0.100)

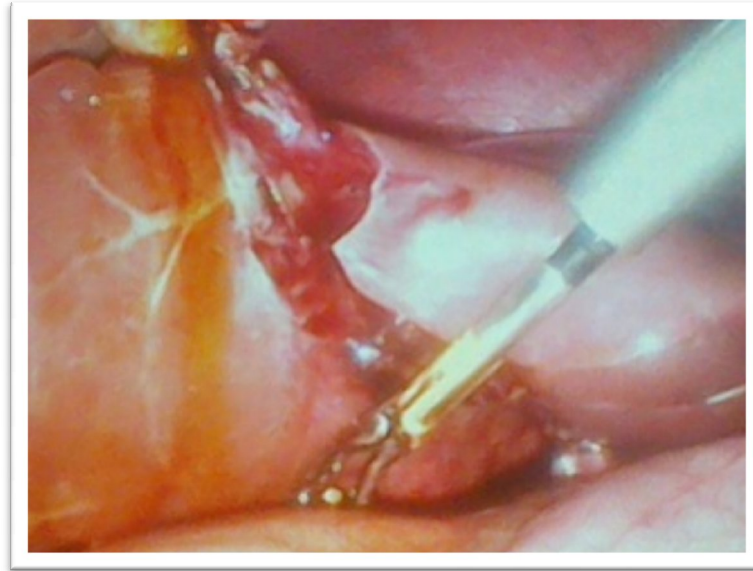


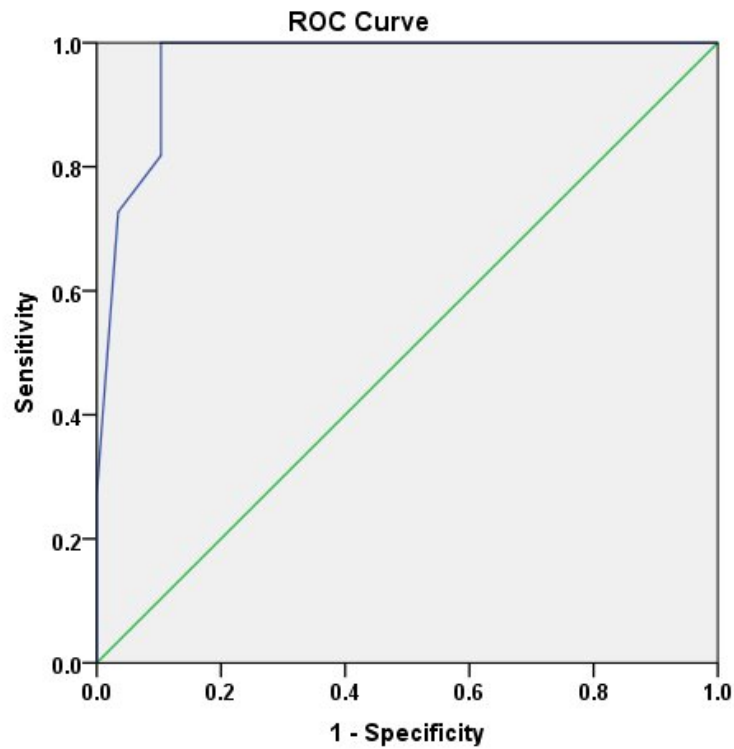
Figure 16 Difficult case showing bile and stone spillage

TABLE 5. OUTCOME ANALYSIS

Risk factors	Level	Peroperative Outcome		P Value
		Difficult No. (%)	Easy No (%)	
Age	<=50	2 (18.2%)	27 (93.1%)	0.000**
	>50	9 (81.8%)	2 (6.9%)	
Sex	Female	5	22	0.055
	Male	6	7	
Hospitalization	Nil	2	28 (96.6%)	0.000**
	Yes	9	1 (3.4%)	
BMI	<=25	3 (27.3%)	26	0.000**

			(89.7%)	
	25.1- <=27.5	2 (18.2%)	3 (10.3%)	
	>27.5	6 (54.5%)	0 (0.0%)	
Abdominal Scar	No	9	14	0.058
	Infraumbilical scar	2	14	
	Supraumbilical Scar	0	1	
Palpable GB	Nil	7 (63.6%)	29 (100.0%)	0.001**
	Yes	4 (36.4%)	0 (0.0%)	
Wall Thickness	Normal	7 (63.6%)	26 (89.7%)	0.050*
	Thickened	4 (36.4%)	3 (10.3%)	
Peri collection GB	Nil	10 (90.9%)	28 (96.6%)	0.464
	Yes	1(9.1%)	1(3.4%)	
Impacted Stone	Nil	10 (90.9%)	29 (100.0%)	0.100
	Yes	1(9.1%)	0 (0.0%)	

ROC Curve analysis



Area Under the Curve = 0.967

The ROC curve analysis result showed that the best cutoff score value to classify “**Difficult**” is ≥ 3 . That is if the score is greater than or equal to 3 we can say that it will a “**Difficult**”.

Sensitivity and Specificity analysis.

		Out come		Total
		Difficult	Easy	
Score classification	Difficult (≥ 3)	11	3	14
	Easy (< 3)	0	26	26
Total		11	29	40

Parameter	Estimate	Lower - Upper 95% CIs
Sensitivity	100.00%	(74.12, 100.00)
Specificity	89.66%	(73.61, 96.42)
Positive Predictive Value	78.57%	(52.41, 92.43)
Negative Predictive Value	100.00%	(87.13, 100.00)
Diagnostic Accuracy	92.50%	(80.14, 97.42)

DISCUSSION

Laparoscopic cholecystectomy is the fantasy of this era of minimally invasive surgery. What would look simple might not be simple all the time and in that case the consequences could be devastating. Hence there needs to be a way in which a difficulty could be anticipated preoperatively.

Of the multiple preoperative variables analysed, age > 50, history of previous hospitalisation for an acute attack of cholecystitis, obesity, palpable gallbladder and wall thickness > 4mm were found to be significant predictors of a difficult outcome.

AGE.

81.8% of cases were associated with an age greater than 50 and history of hospitalisation and were found to be strongly significant with a p value of 0.000. As in our study, many series have reported an association of advanced age and a difficult outcome [52, 53]. Fried et al reported a conversion rate of 5.4% with increasing age and male gender against a conversion rate of 1.9% for women younger than 50 years [52, 53, 56 and 60]. The strong association between age and a difficult outcome could probably be due to the presence of comorbidities. Age

probably cannot be taken as an independent risk factor and its association with multiple other factors in correlating with a difficult outcome would be more meaningful.

GENDER

Male gender was a significant predicting factor in studies conducted at many institutions worldwide, the same was true more so in emergency settings [51, 53, 56]. In an elective setting, Jethwani et al reported a conversion rate of 6.3% for men and 4.5% for women. On the contrary, Jeremy et al reported a conversion rate of 12.6% (double) for men presenting with acute cholecystitis in his series involving 1377 patients in 2007. Our study, having been conducted at an elective setting, we could not study the influence of gender on the outcome and in ours, it turned out to be insignificant.

OBESITY

Obesity as a risk factor was observed in 72.7% of cases with a p value of 0.000. Out of the 11 difficult cases, two cases had a score <5 and yet turned out to be difficult and in them the significant factor was obesity. Rosen et al in his series of 1347 cases observed a body mass index(BMI) >30kg/m² as significant, while yet another recent study

conducted by Jaskiran et al states a BMI > 27.5 as significant. In the range of 25-27.5, the coexistence of other factors resulted in a difficult outcome, whereas in cases with a BMI greater than 27.5, obesity solely was the significant predictive factor.

The risk could be well explained by factors such as difficult access due to thick abdominal wall, difficulties in creating pneumoperitoneum, fat laden omentum and falciform ligament which hinder the view of Calot's triangle and a fatty liver which would be difficult to retract. Although obesity has been considered a risk factor for increased conversion [51, 52, 53,60], it's still not a contraindication to laparoscopic surgery [59] and decision making should be individualised.

PREVIOUS HOSPITALISATION

When it came to previous history of hospitalisation for acute cholecystitis, 81.8% of difficult cases had a positive history and 90% of times, individuals with a positive history had a difficult outcome and therefore it was meaningful to assign this variable a score of 4. This is supported by data from different institutions in studies conducted nationwide [53, 54] as well as internationally. Nuri et al and Murat et al found previous attack of cholecystitis to be a significant predictor [55].

PREVIOUS ABDOMINAL SURGERY

Simopoulos et al and Nuri et al in two different studies found previous abdominal surgery to be significantly adding on to the risk of getting a difficult outcome. But in our case it was not found to be significant as most of them were cases of puerperal sterilisation. The risk in cases with previous surgery is usually attributed to the scar, which makes port entry difficult, though not encountered in our study [55,56].

PALPABLE GALLBLADDER

Clinically palpable gallbladder has so far been included in only one study conducted by Jaskiran et al in 2007 in his series of 228 cases and was found to be significant. Our study had 4 cases with palpable gallbladder and was found to be associated with 36.4% of difficult cases. None with a palpable gallbladder had an easy outcome and the factor was found to be significant(p 0.001)

SONOLOGICAL FEATURES

Preoperative ultrasound has been studied worldwide in multivarious studies and has been found to have a significant contribution. Thickness of gallbladder wall > 4mm, presence of fluid

around gallbladder and impacted stones were studied. Out of them, thickened gallbladder wall was found to be significant as supported by evidence from Fried et al and Nuri et al in 1994 and 2000 respectively.

A meta-analysis of certain diagnostic characteristics of ultrasonography, which was published in 1994 [57, 58] has revealed a sensitivity and specificity of 94% and 78% respectively. Nachnani et al and Supe et al in 2005 had identified the significant predictors of conversion to be male gender, body mass index > 30, past history of acute cholecystitis and Gall bladder wall thickness > 4mm [58].

The role of pericholecystic fluid and impacted stone could not be evaluated since the study was conducted in an elective setting and not many patients presented to us with the above mentioned features.

Two cases turned out to be difficult, with one requiring conversion without reaching scores greater than 10. Hence it is the combination of factors and the clinical judgement that is important rather than the actual score.

LIMITATIONS

- A small number of patients included in the study.
- Only elective cases are studied.
- Anatomical variations not encountered and hence their influence not validated.
- Effect of comorbidities on the outcome not studied.
- Cases that required conversion did not match with very high score (greater than 10).
- The influence of common bile duct stones and dilated duct on predicting difficulty not evaluated, which have been found to significant in certain studies.

CONCLUSION

As laparoscopic cholecystectomy has been widely accepted as the gold standard for the management of gallstone disease, one has to have adequate expertise in the same, as well as in the open approach so as to manage complications. From our study, it is evident that it is possible to identify the risk factors preoperatively and in a cost effective way too. Predicting preoperatively a difficult outcome is important for, any untoward complications that might occur would overshadow all the advantages of laparoscopic surgery and make it an unsafe option. This prediction might as well avoid wasteful attempts at laparoscopic approach. Risk stratification would ensure patient safety and safety of the surgeon as well by avoiding litigation.

BIBLIOGRAPHY

1. Beal JM. Historical perspective of gall stone disease. *Surg Gynecol Obstet* 1984; 158:81.
2. Utpal de: Evolution of cholecystectomy: A tribute to Carl August Langenbuch. *Indian Journal of Surgery, Vol. 66, No. 2, Mar-Apr, 2004, pp. 97-100*
3. Shehadi WH. The biliary system through the ages. *Int Surg* 1979;64:63.
4. Michael J.Zinner, Stanley M.Ashley, Maingot's Abdominal Operations, 11th ed.,
5. Thomas W. Sadler PhD: Langman's Medical Embryology.
6. Charles J.Yeo: Shackelford's Surgery Of The Alimentary Tract, 6th edition
7. Skandalakis JE, Gray SW, Rowe Jr JS: *Biliarytract*.
In: Skandalakis JE, Gray SW, ed. *Anatomical Complications in General Surgery*, New York: McGraw-Hill; 1983:31.
8. Rock J, Swan KG, Diego J: Calot's triangle revisited. *Surg Gynecol Obstet* 1981; 153:410.
9. Benson E, Page RE: A practical reappraisal of the anatomy of the extrahepatic bile ducts and arteries. *Br J Surg* 1976; 63:853.
10. Scott-Conner CEH, Hall T: Variant arterial anatomy in laparoscopic cholecystectomy. *Am J Surg* 1992; 163:590

11. Niebergall-Roth E, Teyssen S, Singer MV: Neurohormonal control of gallbladder motility. *Scand J Gastroenterol* 1997; 32:737
12. Svenberg T, Christofides ND, Fitzpatrick ML, et al: Interdigestive biliary output in man: Relationship to fluctuations in plasma motilin and effect of atropine. *Gut* 1982; 23:1024.
13. Klein A, Lillemoe K, Yeo C, Pitt HA: *Liver, biliary tract, and pancreas*. In: O'Leary J, ed. *Physiologic Basis of Surgery*, Baltimore: Wilkins & Wilkins; 1996:441-478.
14. Tandon RK. Prevalence and type of biliary stones in India. *World J Gastroenterol*, 2000; 6(suppl3):4-5
15. Eun-Hyung Yoo, Soo-Youn Lee: The prevalence and risk factors for gallstone disease. *Clinical Chemistry and Laboratory Medicine*. Volume 47, Issue 7, Pages 795–807, June 2009
16. Nakeeb A, Comuzzie AG, Martin L, et al: Gallstones: Genetics versus environment. *Ann Surg* 235:842, 2002.
17. G.L. Gill, W.H. Mair, J.C. Goligher: Gallstones after ileostomy and ileal resection. *Gut* 1975; 16:932-936
18. Admirand WH, Small DM. The physicochemical basis of cholesterol gallstone formation in man. *J Clin Invest*. 1968; 47:1043–1052
19. Strasberg SM: The pathogenesis of cholesterol gallstones a review. *J Gastrointest Surg* 2:109, 1998

20. Holzbach RT: Recent progress in understanding cholesterol crystal nucleation as a precursor to human gallstone formation. *Hepatology* 1986; 6:1403-1410.
21. Holzer A, Harsch S, Renner O, Strohmeyer A, Schimmel S, Wehkamp J, Fritz P, Stange EF. Diminished expression of apical sodium-dependent bile acid transporter in gallstone disease is independent of ileal inflammation. *Digestion*. 2008;78(1):52-9.
22. Attili AF, De Santis A, Capri R, et al: The natural history of gallstones: The GREPCO experience. The GREPCO Group. *Hepatology* 21:655, 1995.
23. MD Gary D. Friedman Natural history of asymptomatic and symptomatic gallstones *The American Journal of Surgery* Volume 165, Issue 4, April 1993, Pages 399–404
24. Strasberg SM: Cholelithiasis and acute cholecystitis. *Baillieres Clin Gastroenterol* 11:643, 1997.
25. Lo CM, Liu CL, Lai EC, et al: Prospective randomized study of early versus delayed laparoscopic cholecystectomy for acute cholecystitis. *Ann Surg* 1998; 227:461-464.
26. Rutledge D, Jones D, Rege R, et al: Consequences of delay in surgical treatment of biliary disease. *Am J Surg* 2000; 180: 466-469.
27. Uchiyama K, Onishi H, Tani M, et al: Timing of cholecystectomy for acute cholecystitis with cholecystolithiasis. *Hepatogastroenterology* 2004; 51:346-348.

28. Boboev BD. [Ultrasonography in the diagnosis of cholelithiasis and its complications]. *VestnKhirIm I IGrek*. 2012;171(2):21-4.
29. Jansen S, Jorgensen J, Caplehorn J, Hunt D, Preoperative ultrasound to predict conversion in laparoscopic cholecystectomy: *Surg LaparoscEndosc*. 1997 Apr;7(2):121-3.
30. Lee HJ, Choi BI, Han JK, et al: Three-dimensional ultrasonography using the minimum transparent mode in obstructive biliary diseases: Early experience. *J Ultrasound Med* 21:443, 2002.
31. Ralls PW, Jeffrey RB Jr., Kane RA, et al: Ultrasonography. *Gastroenterol Clin North Am* 31:801, 2002.
32. Wexler RS, Greene GS, Scott M: Left hepatic and common hepatic ductal bile leaks demonstrated by Tc-99m HIDA scan and percutaneous transhepaticcholangiogram. *Clin Nucl Med* 19:59, 1994.
33. Liu TH, Consorti ET, Kawashima A, et al: Patient evaluation and management with selective use of magnetic resonance cholangiography and endoscopic retrograde cholangiopancreatography before laparoscopic cholecystectomy. *Ann Surg* 234:33, 2001.
34. David R. Fletcher, Michael S.T. Hobbs, Complications of Cholecystectomy: Risks of the Laparoscopic Approach and Protective Effects of Operative Cholangiograph- A Population-Based Study, *ANNALS OF SURGERY* Vol. 229, No. 4, 449-457.

35. Roslyn JJ, Binns GS, Hughes EX, et al: Open cholecystectomy: A contemporary analysis of 42,474 patients. *Ann Surg* 1993; 218:219-229.
36. Chen AY, Daley J, Pappas TN, et al: Growing use of laparoscopic cholecystectomy in the national Veterans Affairs Surgical Risk Study: Effect on volume, patient selection, and selected outcomes. *Ann Surg* 1998; 227:12-24.
37. Jatzko G, Lisborg PH, Perti AM, et al. Multivariate comparison of complications after laparoscopic cholecystomy and open cholecystectomy. *Ann Surg*. 1995;221:381–6.
38. S.Duca, OBălă, N Al-Hajjar, C Iancu, IC Puia, D Munteanu, and F Graur:Laparoscopic cholecystectomy: incidents and complications. A retrospective analysis of 9542 consecutive laparoscopic operations, *HPB (Oxford)*. 2003; 5(3): 152–158
39. Vikas Gupta, NisarChowdri, Nazir Ahmad Wani,SameerNaqash: LAP V/S Open Cholecystectomy:A Prospective Study of 800 Patients,*www.jkscience.org* Vol. 11 No. 1, January-March 2009
40. J.BuenoLledó, M.PlanellsRoig, C.ArnauBertomeu et al.,Outpatient laparoscopic cholecystectomy. A new gold standard forcholecystectomyREV ESP ENFERM DIG (Madrid)Vol. 98. No.1, pp. 14-24, 2006
41. Forrest Calland, MD, Koji Tanaka, BA, Eugene Foley, Outpatient laparoscopic cholecystectomy: Implementation of a clinical pathway *Ann Surg*. 2001 May; 233(5): 704–715

42. Voyles CR, Berch BR. Selection criteria for laparoscopic cholecystectomy in an ambulatory care setting. *Surg Endosc* 1997; 11: 1145-6.
43. Novitsky YW, Kercher KW, Czerniach DR, Kaban GK, Khera S, Gallagher-Dorval KA, Callery MP, Litwin DE, Kelly JJ: Advantages of mini-laparoscopic vs conventional laparoscopic cholecystectomy: results of a prospective randomized trial. *Arch Surg*. 2005 Dec;140(12):1178-83.
44. Barkun JS, Barkun AN, Sampalis JS, et al. Randomized controlled trial of laparoscopic versus mini-cholecystectomy. *Lancet* 1992;340
45. Marks JM, Phillips MS, Tacchino et al., Single-incision laparoscopic cholecystectomy is associated with improved cosmesis scoring at the cost of significantly higher hernia rates: 1-year results of a prospective randomized, multicenter, single-blinded trial of traditional multiport laparoscopic cholecystectomy vs single-incision laparoscopic cholecystectomy. *J Am Coll Surg*. 2013 Jun;216(6):1037-47
46. Sohn BS, Kim SR, Park IY, Kim EJ Transvaginal laparoscopic cholecystectomy (hybrid NOTES cholecystectomy). *J Laparoendosc Adv Surg Tech A*. 2010 Apr;20(3):245-7.
47. Lucian Panait, MD, Stephanie G Wood, MD, Robert L Bell, MD, Andrew J Duffy, MD, Kurt E Roberts, Transvaginal Notes Cholecystectomy: Key Technical Points, Society of American Gastrointestinal and Endo Surgeons.

48. Alponat A, Kum CK, Koh BC, et al. Predictive factors for conversion of laparoscopy Cholecystectomy. *World J Surg* 1997; 21: 629-33
49. Wiebke EA, Pruitt AL, Howard TJ et al. Conversion of laparoscopic to open Cholecystectomy. An analysis of risk factors. *Surg Endosc* 1996; 10: 742-5.
50. Michael R, Fred B, Ponsky J. Predictive factors for conversion of laparoscopic Cholecystectomy. *Amer. J Surg* 2002; 184(3): 254-8.
51. Rosen M, Brody F, Ponsky J. Predictive factors for conversion of laparoscopic cholecystectomy. *Am J Surg*. 2002 Sep; 184(3): 254-8.
52. Fried GM, Barkun JS, Sigman HH, Joseph L, Clas D, Garzon J, Hinchey EJ, Meakins JL. Factors determining conversion to laparotomy in patients undergoing laparoscopic cholecystectomy. *Am J Surg*. 1994 Jan; 167(1): 35-9; discussion 39-41
53. Gabriel R, Kumar S, Shrestha A: Evaluation of predictive factors for conversion of laparoscopic cholecystectomy, Kathmandu University Medical Journal (2009) Vol 7, No.1, Issue 25, 26-30.
54. Jaskiran S. Randhawa. Aswini K. Pujahari. Preoperative prediction of difficult lap chole: a scoring method 198 *Indian J Surg* (July–August 2009) 71:198–201

55. Nuri et al. A risk score for conversion from laparoscopic to open cholecystectomy. *The American Journal of Surgery* Volume 181, Issue 6, Pages 520-525, June 2001
56. Simopoulos, Botaitis, Polychronidis: Laparoscopic cholecystectomy in obese patients. *Obes Surg* (2005)
57. Nachnani J, Supe A: Pre-operative prediction of difficult laparoscopic cholecystectomy using clinical and ultrasonographic parameters. *Indian J Gastroenterol* 2005, 24:16-8.
58. Jansen S, Jorgensen J, Caplehorn J, Hunt D: **Preoperative ultrasound to predict conversion in laparoscopic cholecystectomy.** *Surg Laparosc Endosc* 1997, 7(2):121-3
59. C. Simopoulos, Botaitis, A. Polychronidis: Risk factors for conversion of laparoscopic cholecystectomy, *Surg Endosc* (2005) 19:905-909.
60. Tayeb M, Raza SA, Khan M R, Azami R. Conversion from laparoscopic to open cholecystectomy: Multivariate analysis of preoperative risk factors. *J Postgrad Med* 2005;51:17-20

PROFORMA

SL. NO:

NAME :

AGE /SEX:

IP NO:

ADDRESS WITH CONTACT NUMBER:

DATE OF ADMISSION:

DATE OF DISCHARGE/ DEATH:

HISTORY OF PRESENTING ILLNESS:

H/O abdomen pain- onset
duration
progression
radiation
aggravating/relieving factors

H/O dyspepsia

H/O nausea/vomiting

H/O abd.distension

H/O fever, jaundice, pruritus

H/O high colored urine , clay colored stools.

PAST HISTORY:

H/O Diabetes mellitus/hypertension/asthma/TB/epilepsy/cardiac illness

H/o similar episodes in the past, if any:

H/o major illness/ hospital admissions, if any

PERSONAL HISTORY:

Whether a smoker or an alcohol consumer

FAMILY HISTORY:

TREATMENT HISTORY:

CLINICAL EXAMINATION:

General examination:

systemic examination:

CVS

RS

CNS

Per abdomen

Clinical diagnosis:

INVESTIGATIONS:

Complete blood count

Random blood sugar

Renal function test: Blood urea, serum creatinine

Liver function test

Chest X ray, ECG

Ultrasonogram

FINAL DIAGNOSIS:

