INCIDENCE OF BILE DUCT INJURIES IN LAPAROSCOPIC Vs OPEN CHOLECYSTECTOMY

A REVIEW OF METHYLENE BLUE INJECTION TECHNIQUE TO PREVENT BILE DUCT INJURIES IN LAPAROSCOPIC CHOLECYSTECTOMY

DISSERTATION SUBMITTED FOR THE DEGREE OF

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BONAFIDE CERTIFICATE

This is to certify that the dissertation entitled **" INCIDENCE OF BILE DUCT INJURIES IN LAPAROSCOPIC Vs OPEN CHOLECYSTECTOMY - A REVIEW OF METHYLENE BLUE INJECTION TECHNIQUE TO PREVENT BILE DUCT INJURIES IN LAPAROSCOPIC CHOLECYSTECTOMY"** is bonafide record work done by **Dr. P.J.GOKULAKRISHNAN** under my direct supervision and guidance, submitted to the Tamil Nadu Dr. M.G.R. Medical University in partial fulfillment of University regulation for M.S. General Surgery, Branch I.

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I **Dr. P.J. GOKULAKRISHNAN** solemnly declare that the dissertation titled **"INCIDENCE OF BILE DUCT INJURIES IN LAPAROSCOPIC Vs OPEN CHOLECYSTECTOMY - A REVIEW OF METHYLENE BLUE INJECTION TECHNIQUE TO PREVENT BILE DUCT INJURIES IN LAPAROSCOPIC CHOLECYSTECTOMY"** has been prepared by me. I also declare that this bonafide work or a part of this work was not submitted by me or any other for any award, degree, diploma to any other University board either in India or abroad.

This is submitted to The Tamilnadu Dr. M. G. R. Medical University, Chennai in partial fulfillment of the rules and regulation for the award of M.S.(General Surgery) Branch – I to be held in March 2008.

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CONTENTS

INTRODUCTION

Gall stones are a major cause of morbidity, to tackle this, Medical fraternity has devised and refined various therapeutic modalities, over these years. To this date surgical modality is the mainstay of treatment and in last decade laparoscopic cholecystectomy undoubtedly has become the gold standard and one of the commonest operations performed today.

Laparoscopic cholecystectomy is an indispensable weapon in armamentarium of today's new age practicing surgeons, hence there is growing need for safer procedures in this era of consumer rights and minimal access surgery.

This study intends to throw some light on safe laparoscopic cholecystectomy in comparison to open procedure.

AIM OF THE STUDY

A study of 71 cases of cholecystectomies (34 lap & 37 open) for symptomatic cholelithiasis over a period of 2 years from July 2005 to July 2007 from a surgical unit.

- To find out the incidence of Bile duct injuries in laparoscopic cholecystectomy with methylene blue dye injection versus routine open cholecystectomy.
- To highlight the use of Methylene blue dye injection to prevent bile duct injuries and to identify congenital anomalies of biliary tract in laparoscopic cholecystectomies.
- To identify the incidence and preoperative predictors for difficult cholecystectomy in laparoscopic approach.

HISTORY

Cholecystectomy is the commonest operation of the biliary tract and second most common operative procedure performed today. Though the technique was developed a century ago by a German Surgeon Carl Johan August Langenbuch, it received little recognition till it became the gold standard for the definitive management of symptomatic cholelithiasis.

Carl Langenbuch is credited with having pioneered the concept and execution of the first gall bladder extirpation.

The first account of Gall stones was given in 1420 by pathologist Antonio Benevieni in a woman who died with abdominal pain.

Since then treatment of gall stones has undergone the process of metamorphosis dating back from 1733 when Jean-Louis Petit removed gall stones and drained gall bladder by creating external fistula.

In 1859, JL.W.Thudichum proposed two stage elective cholecystectomy. Marion Simms performed cholecystostomy on a 45 year old woman for obstructive jaundice in 1878.

It was Carl Lagenbuch who realized the temporary relief provided by above procedures which inspired him to develop the technique of cholecystectomy through cadaver dissection, which he implemented in a 43 yr old patient on July 15 1882.

Lagenbuch's cholecystectomy with few initials denials became the gold standard for years to come.

Technique was further refined by introduction of operative cholangiography by Mirizzi 60 year ago.

With the advent of safer laparoscopic technique which itself has evolved in past 70 years found its use in performing cholecystectomy in last decade.

If Phillippe Mauret who performed the first successful laparoscopic cholecystectomy in 1987. Since then the procedure has enjoyed vast popularity and patient satisfaction and is still evolving.

In September 1992 a NIH consensus conference held in Bethesda concluded that Laparoscopic cholecystectomy was treatment of choice for Gall bladder lithiasis.

SURGICAL ANATOMY

GALL BLADDER :

This is a pear shaped sac about 10 cm in length with 30-60 ml capacity. Main function being concentration of bile (hence its tendency to form stones) and emptying in the gut during a meal.

Position :

It is situated on the inferior surface of segment V of the right liver in a shallow fossa. It is covered with a layer of peritoneum that contains many small veins that require coagulation during cholecystectomy.

It is divided into fundus which has the poorest blood supply especially when distended, the body and the neck or infundibulum which leads to cystic duct.

Frequently infundibulum has an abnormal sacculation which is referred to as HARTMANN's pouch. This may become adherent to the surrounding structures in porta hepatis esp. CBD, obscuring anatomical relationship during dissection.

Relations :

Superiorly it abuts the liver with fundus protruding beyond the inferior margin of the liver. Surface marking of which lies at the intersection of linea semilunaris and ninth costal cartilage. Neck or infundibulum lies near the right of porta hepatis.

Inferior surface of Gall bladder is related to transverse colon, first part of duodenum.

Nerve and Blood supply :

The Gall bladder is supplied by the cystic artery a branch of right hepatic artery. Its an end artery, its occlusion leads to gangrene of the Gall bladder. Venous drainage is by multiple small veins draining into hepatic and portal venous system.

Nerves reach it along the artery from celiac plexus (sympathetic), the vagus (parasympathetic) and right phrenic nerve (sensory).

Lymphatic drainage :

Distally it communicates with those of Glisson’s capsule of the liver and retrosternal lymph nodes.

Proximally it drains into the cystic lymph node of Lundh in Calot's triangle and nodes in the lateral aspect of lower end of the bile duct.

Cystic duct :

Cystic duct has variable course to its termination into CBD, measuring about 2 cm or more in length. Drainage most commonly occurs posteriorly or anteriorly rather than into the right lateral margin of common bile duct as was commonly believed earlier.

Cysto hepatic triangle or Calot's triangle

It is a triangular fold of peritoneum containing cystic duct, cystic artery and cystic node and variable amount of fat. This triangle must be well defined before proceeding with dissection during any cholecystectomy. Cystic lymph node usually located at junction of cystic artery and right hepatic artery. Vast Majority of aberrant / anomalous bile ducts arise from right ductal systems 80% of which are located in Calot's triangle. This triangle is obliterated in presence of Mirizzi's syndrome.

Common Bile Duct :

Common hepatic duct is formed by union of right and left hepatic duct joined at variable distance by cystic duct to form common bile duct. For surgical understanding both are considered same due variable site of drainage of cystic duct.

Bile duct is divided into supraduodenal, retroduodenal, intrapancreatic and intraduodenal. Measures about 11-12 cm and average diameter of 7mm (4-10mm).

Supraduodenal portion is most important in surgical point of view as it is here, where all injuries occur. It lies in the free edge of hepato duodenal ligament to the right of hepatic artery and anterolateral to the portal vein.

Retroduodenal segment curves to right before entering the head of pancreas (Intra pancreatic segment) though 20% have partial or complete extrapancreatic course.

Transduodenal segment which traverses the duodenal wall obliquely, joins the pancreatic duct and opens into the duodenal lumen at the summit of major duodenal papilla surrounded by sphincter of Oddi complex.

Anomalies of Gall Bladder :

- Agenesis of Gall Bladder - Rare can be diagnosed only during surgery
- Phrygian cap. – Most common anomaly
- Floating gall bladder (with mesentery)
- Double or triple gall bladder
- Partial or totally intra hepatic gall bladder
- Accessory cholecystohepatic duct
- Medioposition (under segment IV)
- Sinistroposition (under segment III)

Anomalies of Ducts :

- Absent cystic duct
- Long cystic duct with or without low insertion
- Long cystic duct winding around common hepatic duct
- Cystic duct draining to right hepatic duct
- Accessory hepatic ducts joining common bile duct.

Anomalies of cystic artery :

1. Origin of cystic artery to left of bile duct anterior to CBD
2. Low origin of cystic artery from common hepatic and or gastro duodenal artery
3. Accessory cystic artery arising from the common hepatic artery.
4. Looped right hepatic artery (Moynihan’s hump or caterpillar turn) with cystic artery arising from the summit
5. The right hepatic artery runs close to the cystic duct and the neck of the gall bladder before giving anterior or posterior branches - Most dangerous.

PHYSIOLOGY

Functions of Gall Bladder :

1. Absorption : Concentration of bile by removing 80-90% of water and simple solutes Na+, K+, Cl- and $HCO3^-$ by active transport whereas water is extracted by

1. Associated active ion transport
2. Osmotic gradient

In diseased Gall bladder

a) Water absorption is decreased

b) Probably excretes more cholesterol into the lumen

c) Secretin decreases the absorption and thereby the concentrating capacity of Gall bladder

2. Secretion : Gall bladder secretes – mucus, mucins, mucoproteins, mucopoly saccharides and glycoprotein. Increased secretion occurs in a diseased Gall bladder well known as **white bile** (Misnomer as its neither white nor bile) actually it is mucus secreted by gall bladder where cystic duct is blocked by stone, constitutes the white bile.

Gall bladder kinetics :

Liver secretes bile continuously and is capable of maintaining secretion against all pressures normally encountered. During periods of fasting, bile enters gall bladder, to be stored and concentrated as the pressure in the gall bladder is less than the resistance of the sphincter at lower end of common duct. At the sight of food, there may be some escape of bile into duodenum, but the main out pouring of bile begins about half an hour after food intake.

Control of Gall Bladder emptying :

1. Parasympathetic system is responsible for maintenance of gall bladder tone. After vagotomy there is gall bladder stasis, causes increased risk for stone formation.
2. Cholecystokinin released from duodenal mucosa in response to essential amino acids in food it is a potent stimulant of gall bladder contraction and relaxation of sphincter mechanism.
3. Secretin : i) Potentiates the action of cholecystokinin
   ii) Increases bile secretion by liver
4. Gastrin – increases Gall bladder contraction

5. Drugs :
    i) Morphine – Causes pronounced increase in sphincter resistance alleviated by atropine
    ii) Nitrites - relaxes the sphincter
    iii) MgSO4 – increases Gall bladder tone and relaxes the sphincter

Composition of Bile

	Liver Bile	GB Bile
Water	97.5%	92 %
Bile salts	1.1 gm/dl	6g/dl
Bilirubin	0.04 gm/dl	0.3gm/dl
Cholesterol	0.1 gm/dl	0.3-0.9 gm/dl
Fatty acids	0.12gm/dl	0.3-1.2gm/dl
Lecithin	0.04 gm/dl	0.3gm/dl
Na+	145 in mEq/L	130 mEq/L
K+	5 mEq/L	12mEq/L
Ca2+	5mEq/L	23mEq/L
HCO3	28mEq/L	10mEq/L
Cl-	100 mEq/L	25 mEq/L

Functions of bile :

1. Enhances digestion and absorption of fat by reducing surface tension and emulsifying the fat
2. Helps in absorption of fat soluble vitamins A, D, E and K

3. Bile acids act by formation of micelles, maintain cholesterol and bile pigments in solution and are useful in excretion.
4. Due to presence of $HCO3^-$ in it neutralizes the acid chyme and provides optimum environment for the action of pancreatic enzymes.

MATERIALS AND METHODS

1. Patients subjected to this study are taken from surgical unit of Government Rajaji Hospital, Madurai over a period of two years.
2. Patients were operated (37 open and 34 laparoscopic cholecystectomies) for symptomatic cholecystitis.
3. Epidemiological factors such as age, sex, body mass index, previous surgery, duration and number of attacks were taken into account.
4. Patients were routinely investigated with LFT, OGD, USG abdomen and CT abdomen (if indicated)
5. All cases of laparoscopic cholecystectomies were subjected to Methylene blue dye injection with informed consent, where as open cases were excluded.
6. Material used for dye injection were

   a) Medical grade sterile methylene blue dye

   b) 20 ml disposable syringe

   c) Normal saline

   d) 22 G spinal needle or Veress needle

7. Cholecystectomies were performed by surgeons adequately trained in open surgery and for laparoscopic approach surgery with experience of at least 5 cases, were included.
8. The entity of difficult cholecystectomies was assigned to cases with following criteria
    a) Dense adhesions in the triangle of Calot's
    b) Chronic cholecystitis with fibrotic gall bladder
    c) Previous surgery (upper abdominal)
    d) Gangreneous gall bladder
    e) Acutely inflamed gall bladder
    f) Empyema gall bladder
    g) Mirizzi syndrome
    h) Congenital anomalies of biliary tract
9. Patients were followed up for time period of 3-20 months and those suspected have bile duct injuries, were subjected to serial LFT and if required MRCP.

RESULTS OF STUDY

Table – 1 : Number of cases performed

	Lap	Open
No. of Patients (n=71)	34	37

Total number of conversion - 1

Conversion rate 1/35 - **2.85%**

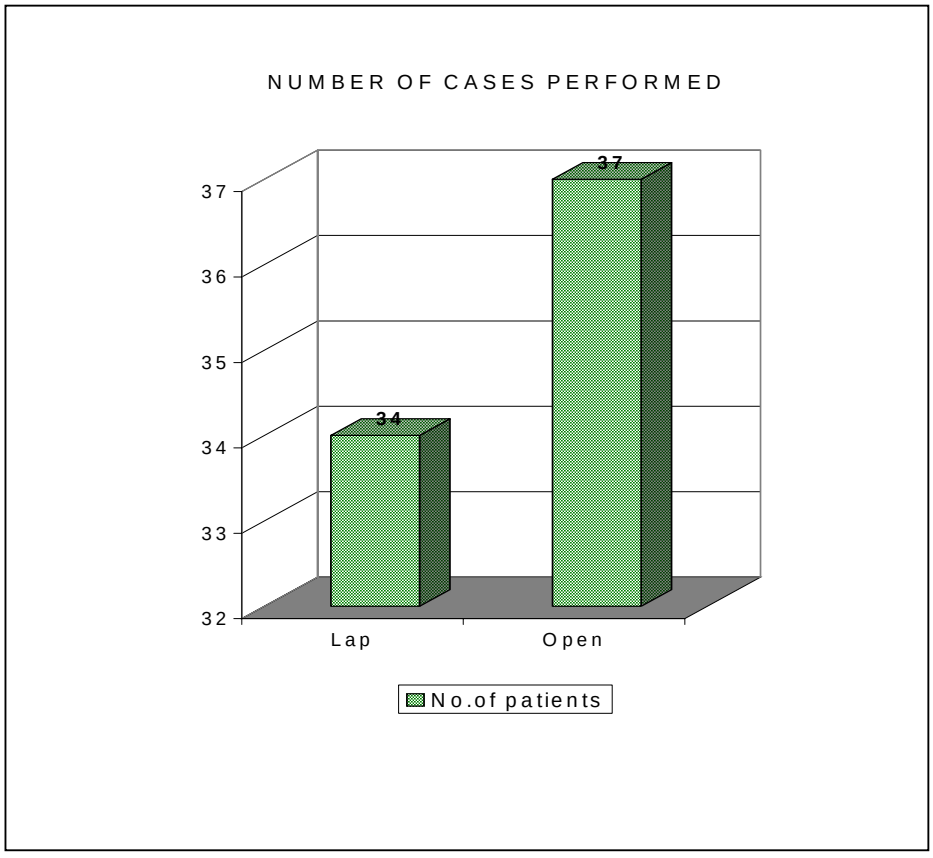


Table – 2 : Type of technique used

Procedure / Technique	Lap (n=34)	Open (n=37)
Cystic duct first	33 (97%)	25(67.5%)
Fundus first	1 (3%)	12 (32.5%)

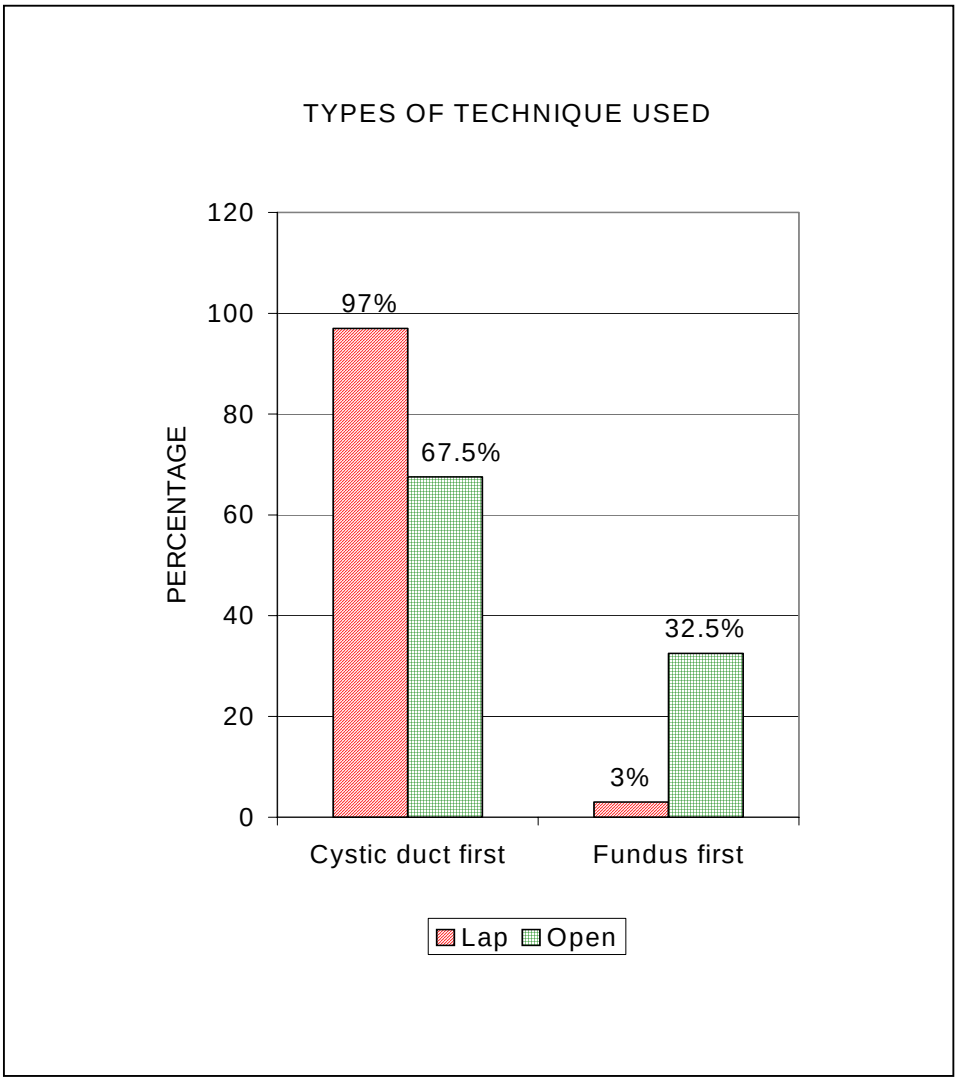


Table – 3 : Average time taken for the procedure (Including the time taken for methylene blue injection in laparoscopic approach)

	Lap (n=34)	Open (n=37)
Time (min)	59 mins	60 mins

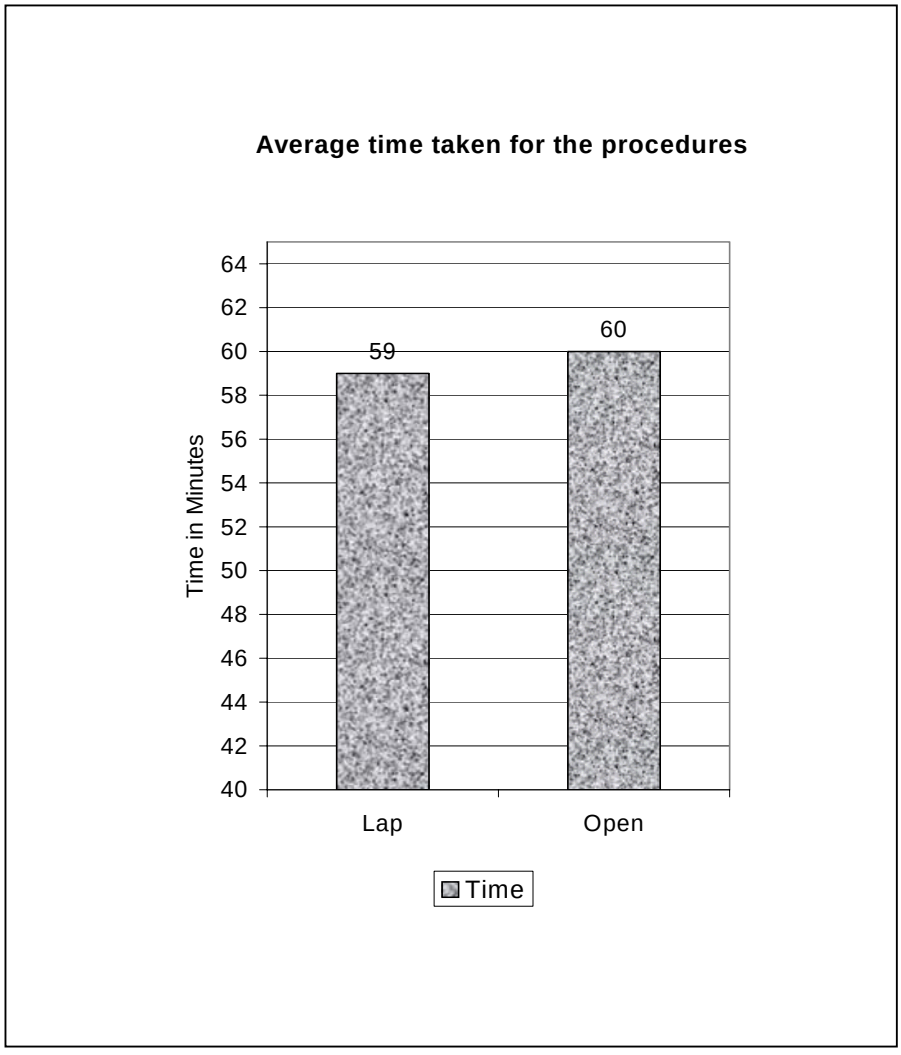


Table – 4 : Incidence of bile duct injuries in Lap (with methylene blue injection) Vs Open

Procedure / Bile duct inj.	Lap (n=34)	Open (n=37)
Minor	0	0
Major	0	1 (2.7%)

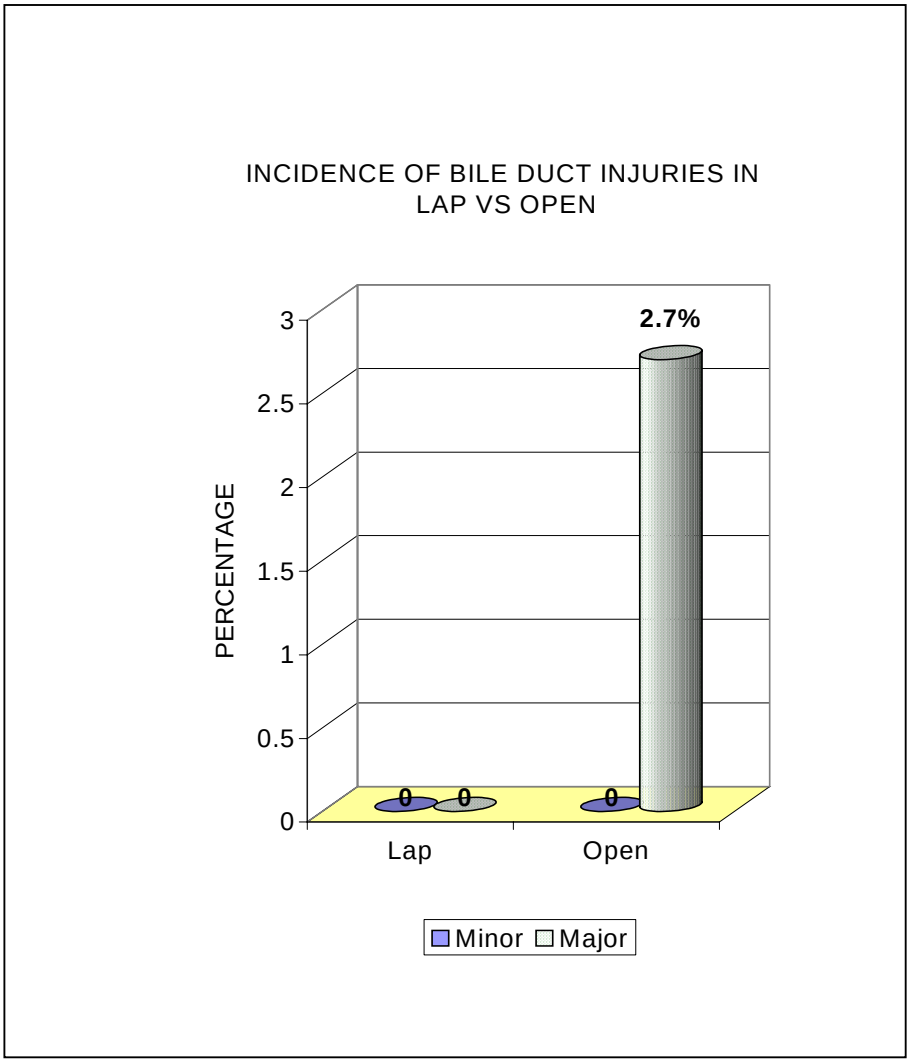


Table – 5 : Incidence of Other Complications

	Lap (n=34)	Open (n=37)
Wound / Port site infection	1 (2.9%)	2 (5.4%)
Wound dehiscence	0	1 (2.7%)
Respiratory Infection	0	1 (2.7%)
Port site / Incisional hernia	0	1 (2.7%)
Overall complication	2.9%	13.5%

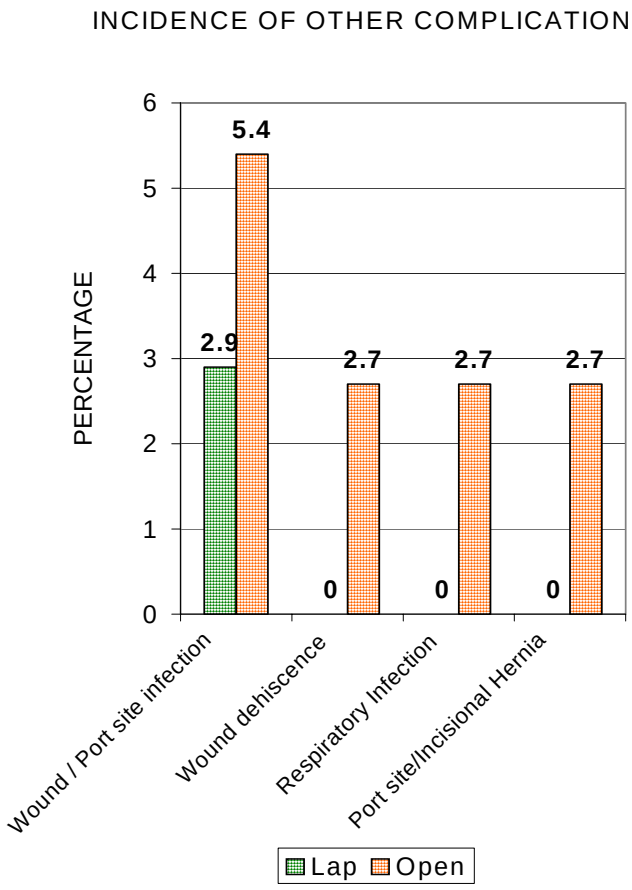


Table – 6 : Incidence of difficult cholecystectomies and its distribution (Laparoscopic approach only)

Difficult cholecystectomies	n = 6
Acute inflammation	1 (16.6%)
Dense adhesions in Calot's triangle	2 (33.33%)
Previous surgery	1(16.6%)
Contracted GB	1 (16.6%)
Gangreneous GB	1 (16.6%)

Incidence : 6/35 : **17.5%**

Conversion Rate: 1/6 : **16.66%**

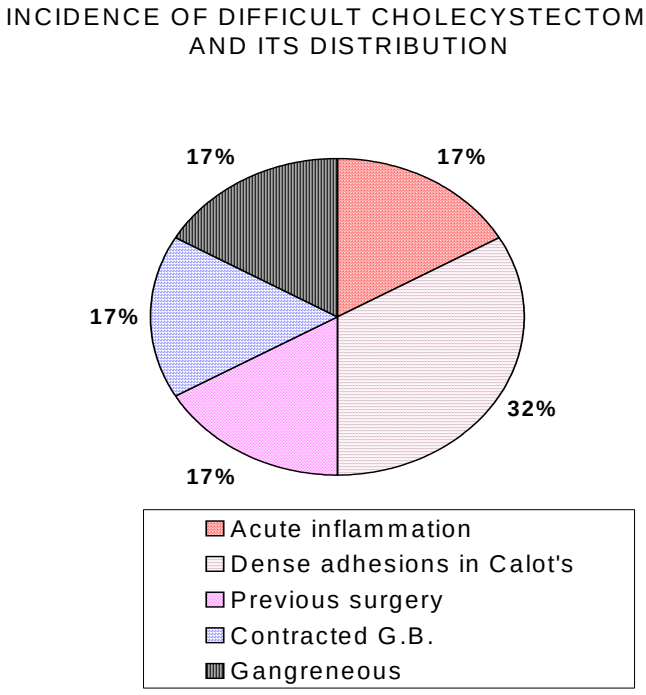


Table – 7 : Pre-operative predictors for difficult Laparoscopic cholecystectomies

Predictive Factors →	No.of attacks	Duration of symptoms (months)	BMI	Previous Surgery	Acute inflammation
Difficult cholecystectomy	8.5	10 months	30	16.66%	16.66%
Routine cholecystectomy	4	4 months	26.2	2.94%	Nil

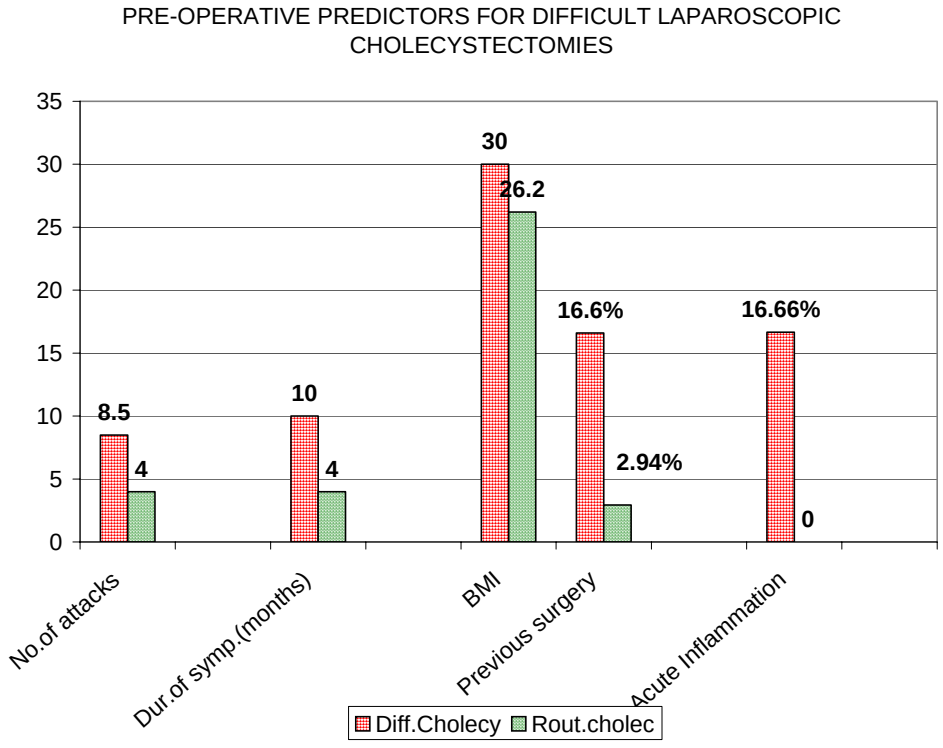


Table – 8 : Surgeon's Experience as a factor in bile duct injury

Surgeon's Exp.	Bile duct injury
< 10 cases	1
10 – 20 cases	0
> 20 cases	0

Table – 9 : Mode of management adopted for Bile duct injury

Management → / Type of Inj.	Serial LFT	Conservative Management	MRCP	ERCP Management	Surgical Management (Bilary enteric bypass)
Minor (n=0)	-	-	-	-	-
Major (n=1)	Yes	No	Yes	No	Yes

REVIEW OF LITERATURE

Incidence of bile duct injury in our study was restricted only to open cholecystectomy (2.7%) which was a major transection injury involving common bile duct, way higher than reported in standard literature of about 0.125% (1 in 800). Biliary continuity was restored with Roux-en-Y hepatico jejunostomy electively, months after a emergency laparotomy where in a large bilioma was drained.

Interestingly incidence of bile duct injury in laparoscopic cholecystectomy was nil (0%) in comparison to Strassberg et al data of 0.55% to 0.85%. This could be attributed to following reasons.

- Meticulous technique of Safe Laparoscopic cholecystectomy
- Use of Methylene blue injection to delineate biliary anatomy

	Bile Duct Injury (%)	
	LC	OC
Our study	**0 %**	**2.7%**
Strassberg et al	0.55-0.85%	0.125%
Daziel et al	0.6%	-
Fullarton et al	0.7%	-
Brune et al	0.2%	-
Litwin et al	0.1%	-

Overall conversion rate in our study was **2.85%** in comparison to various series which ranges from 1.2% - 17%

	Conversion Rate %
Fullarton et al	17%
Liturin et al	4.3%
Brune et al	1.2%
Our study	**2.85%**

Conversion of laparoscopic approach to open was in a case gangreneous gall bladder, distended, fragile and was difficult to grasp and with laparoscopic instruments. Moreover methylene blue could not be injected due to obvious reasons as the color of Gall bladder wall bluish black.

Average operative time in our study of laparoscopic cholecystectomy was significantly low (59 min) in spite of the time consumed in methylene blue injection. This probably may be due to color contrast offered by methylene blue colored ducts which enables faster dissection.

	Operative time (mins)	
	LC	OC
Our study	**59**	**60**
Barkun et al	86	73
Trondsen et al	100	50
Majeed et al	65	40

Overall incidence of other complications were significantly higher in open cholecystectomy (13.5%) whereas it was minor wound infection in one case in laparoscopic arm (2.9%).

Incidence ‘Difficult cholecystectomy based on intraoperative pathology in our study was 17.5%, commonest presentation being of dense adhesions in the triangle of Calot`s. Incidence reported by Kuldhip Singh et al in large series from North India was 22.67 where in commonest presentation was acute inflammation of Gall bladder. There was no case of congenital anomalous biliary ducts in our study.

As shown by our study, *number of attacks of pain , duration of symptoms, obesity, acute onset symptom and previous upper*

abdominal surgery are found to valuable preoperative indicators to anticipate difficult cholecystectomy.

Age and sex did not bear any significance in this regard. Surgeon experience with both approaches especially laparoscopic can be considered a risk factor for bile duct injury as shown in our study and in literature (Southern surgeons club).

Most of the cases in laparoscopic arm were accomplished by ‘cystic duct first’ technique (97%) where as one third of cases in open approach was done by ‘fundus first’ technique. This can be attributed to magnified and clear vision of Calot’s triangle through a laparoscope.

DISCUSSION

BILE DUCT INJURIES :

Bile duct injuries are associated with significant morbidity, prolonged hospitalization, increased financial burden, potential litigation and occasional mortality. It is the third most common litigated general surgical complications in western statistics, also it has been reported that average two procedures (between 1 to 8) are required for definitive repair of bile ducts. Bile duct injury if fortunately identified and repaired peroperatively, carry less morbidity and mortality.

In the era of laparoscopic cholecystectomy bile duct injuries has gained tremendous amount of attention. Laparoscopic cholecystectomy in its earlier days was ill famed due to the high incidence of bile duct injury. With refinement of technique and various factors incidence of bile duct injury has become surprisingly low (0.3 – 0.6% Vs Open 0.125%).

With the huge number of Laparoscopic cholecystectomy performed today even this fraction carries a substantial economic impact.

Many advancements in this field are in vogue to decrease the incidence of bile duct injuries to low minimum like, IOC, defining technique for safe cholecystectomy, sophisticated new generation laparoscopic instruments, per operative dye injection are few to mention.

Types of Injury

- Bile leaks (Usually minor)
- Bile duct transections / stricturing type (Major)

Bile leaks :

Minor, Bile duct injuries occur in a frequency of 0.3% worldwide. Common causes are :-

- Leak from cystic duct stump (may be due to slippage of clip during suction and irrigation after removal of GB)
- Transected aberrant right hepatic duct
- Lateral injury to the main bile duct (<25% of circumference)
- Rarely due to unidentified cholecysto hepatic duct

These injuries usually present within 1 week of laparoscopic cholecystectomy with pain, fever and mild hyper bilirubinaemia (up to 2.5 mg /dl) from a bilioma or bile peritonitis. Symptoms may be subtle initially. If drain is placed, bile may leak from it or through one of the port sites. Diagnosis should be considered in patients presenting with bloating or anorexia more than few days after laparoscopic cholecystectomy.

Even though minor, it can present very late with bile duct strictures (esp. lateral wall injuries months to years after the procedure).

Bile duct Transections / Stricturing injury :

The incidence of these major injuries are 0.55% - 0.6 % world wide ,commonest of these are

1. Clip placement in common bile duct or right heptatic duct mistaken for cystic duct.
2. Excessive use of monopolar cautery to control bleeding and in difficult dissections.

Recognized fairly late in post operative period and there are no immediate symptoms or signs until jaundice presents. Jaundice may

painless or with pain if cholangitis complicates the situation. Less commonly, patient may present fairly late (months to years) with cholangitis, cirrhosis and portal hypertension.

Classification of Bile duct injuries :

Commonest used is Corlette –Bismuth classification which classifies major Bile duct transections and strictures of extra hepatic biliary type.

Bismuth Classification

Type I - Low common hepatic stricture,
length of the stump > 2cm

Type II - Higher strictures
Length of the CHD stump < 2 cm

Type III - High hilar strictures – no serviceable CHD but the confluence of right and left hepatic duct is intact

Type IV - Involvement of confluence with no communication between right and left hepatic ducts
Fibrosis in between the two ducts may be thin (<1cm) thick (1cm or more)

Type V - Combined common hepatic and aberrant right hepatic duct injury separating both from distal biliary tract.

Advantages of Bismuth classification :

1. Length of the remnant stump determines the type of repair
2. Indicates prognosis, morbidity and chance of recurrence after the indicated repair.

Disadvantage :

- Does not indicate the length of the stricture as in present era small length strictures can be dealt non-operatively.
- Does not include minor biliary tract injuries which require management
- Does not mention the continuity across the injury.

More recently **Strassberg classification,** out lines a comprehensive classification of bile duct injuries which is gaining wider acceptance.

STRASSBERG CLASSIFICATION

Type A :

Bile leak from a minor duct that is still in continuity with common bile duct. Usually from cystic duct stump or gall bladder bed. Does not cause strictures or require tertiary referral.

Type B :

Occlusion of part of biliary tree usually it is aberrant right hepatic duct mistaken for cystic duct. Often asymptomatic may present later with pain and cholangitis.

Type C :

Bile leak from a duct not in communication with distal common bile duct. Usually transection of right aberrant hepatic duct with drainage of bile into peritoneal cavity presents early in post operative period.

Type : D

Lateral injury to extrahepatic bile duct. The hepatic parenchyma remains in communication with the distal end of biliary tree, might result in stenosis.

Type E :

Circumferential injury of major extrahepatic ducts with separation of liver parenchyma from the lower ducts and duodenum. (Type E1- E5 is same as type 1-5 of Bismuth classification)

Modes of Injury during Laparoscopic Cholecystectomy

Basic two error groups which lead to bile duct injuries are :

1. Misinterpretation of anatomy
2. Technical Error

Misinterpretation of anatomy:

As a broad term is responsible for 70% of Bile duct injuries as concluded in retrospective analysis. Confirming and reconfirming the key anatomical structures before dividing or clipping is the key to avoid bile duct trauma.

Technical errors :

Technique of ‘Safe cholecystectomy’ is crucial for any uneventful cholecystectomies. ‘Classical injury’ which leads to bile duct injury is when, cystic duct is retracted, cephalad instead

of lateral traction which brings BD in line with cystic duct, this eventually leads to application of clips partially or totally on to CBD which leads to total transection of CBD without continuity. (Strassberg type E)

Hilar bleeding and its desperate control accounts for many high injuries, this usually is due to cystic artery bleeding or due looped right hepatic artery (Moynihan's Hump).

Other causes of injuries are :

1. Occlusion of lumen of common bile duct by ligating cystic duct flush at its origin
2. Excessive dissection
3. Excessive use of Monopolar diathermy (conduction and transmission of current while using monopolar diathermy after clipping of cystic artery.)
4. Failure to identify aberrant right hepatic duct.

***Risk factors for Bile duct injuries* :**

Experience of the surgeon : The learning curve

This is the most crucial factor with regards to iatrogenic injury to bile duct during laparoscopic cholecystectomy.

Its not only the technical competence of the surgeons but also the ability to adjust to two dimensional images on the monitor and the lack of depth perception. This is the learning curve which every beginner laparoscopic surgeon must go through and indeed the curve isn't of a similar shape in every one's case.

Southern surgeons club reported initial high rate of bile duct injury (2.2%) during first 13 laparoscopic cholecystectomies per surgeon. This rate fell to 0.1% for subsequent operation.

Improper use of energy sources for dissection :

Any thermal source causes collateral damage and hence their lies a potential risk of delayed injuries to surrounding structures, incidence of such damage is higher in use of monopolar diathermy when compared to bipolar diathermy , and damage is claimed to be least for harmonic scalpel dissection.

Patient factors :

Apart from disease pathology per operatively other factor which predict difficult dissection are :

1. Obesity (as the excessive fat obscures the anatomy of Calot's triangle)
2. Number and duration of attacks

   These directly relate to difficult dissection due formation of dense adhesion with many attacks and its long duration before patient is subjected to Laparoscopic Cholecystectomy.
3. Age and male gender :

   Though considered by few as predictor of difficult cholecystectomies, it only increases the post operative morbity and are not considered as risk factor for difficult cholecystectomy.

Anomalous and Morbid anatomy :

Grossly these conditions are grouped under the entity 'Difficult cholecystectomy' as mentioned later. Broadly these conditions are classified into classes.

Dangerous Anatomy :

These include adhesions / excessive fat in the porta hepatis which obscure the view of vital structures.

Anomalies of biliary tract (10-15%) which are not usually identified preoperatively. Most likely of which creates problems is an aberrant right hepatic duct inserting low into common hepatic bile duct mistaken for cystic duct.

Another important anomaly is a ‘short cystic duct : which may cause lateral wall of CBD injury / remote stricture while applying clips.

Variations in vascular anatomy may present with difficulty usually in terms of haemorrhage which obscures the vision, predisposing to bile duct injury in an attempt to control it.

Dangerous Biliary pathology : These include

- Acute cholecystitis
- Mirizzi syndrome
- Sclero atrophic Gall bladder
- Frozen / fibrosed triangle of Calot`s triangle
- Polycystic liver disease / portal hypertension

Acute cholecystitis presents problems in terms excessive oozing of blood and distortion of anatomy due to active inflammation. Still randomized prospective studies have shown benefit of laparoscopic approach over open procedure (3% minor complication versus 23% major complications and 19% minor complications in open cholecystectomy group)

Threshold for conversion should be low in case if anatomy cannot be delineated. Gall bladder can be aspirated and should not be grasped but retracted bluntly as it may be friable.

Prevention of Bile Duct Injuries in Laparoscopic Cholecystectomy

Bile duct injuries like any disease is better prevent than treated. Key aspects of prevention are

1. Thorough knowledge of the anatomy, risk factors and mechanisms of injury.
2. Meticulous technique of safe cholecystectomy as described.
3. Timely decision for elective conversion to open in the presence of difficulty anatomy.

4. Developing skills of interpreting Intra operative cholangiogram.

Meticulous technique has no substitute in preventing bile duct injuries, proper traction, limiting dissection close to gall bladder. Critical window and display of structures in Calot`s triangle are few to mention.

Concern over the clipping of cystic duct later its slippage causing bile leak is real due to which many surgeons now opt to ligate the cystic duct with transfixing intra corporeal suture or endoloop especially for short cystic duct. Long duct is better dealt with clips.

There is a chance of internalization of these cystic duct clips into bile duct, which acts as nidus for stone formation several months later and possibly stricture.

Methylene blue dye injection is a novel, cost effective and easy technique to prevent bile duct injuries. Its main advantage lies in the fact that dye is injected into gall bladder before any dissection is undertaken contrary to intraoperative cholangiogram which is

done after some dissection has been undertaken when injury might have occurred already.

It provides surgeon a continuous per operative delineation of biliary anatomy hence greatly facilitating dissection.

***Difference between open and laparoscopic bile duct injuries* :**

Laparoscopic injuries tend to be more extensive involving injury to a segment of common bile duct and often extension to higher levels often involving proximal hepatic ducts. About 60-75% are not immediately recognized during surgery.

Occurrence of combined vascular and ductal injuries carry poor prognosis as future it may cause re-stricuturing despite reconstructions due impaired blood supply to the anastamosis. Injury to vessels, also lead to hepatic necrosis / abcess formation rarely.

Open cholecystectomies usually escape with smaller injuries with leaks, stricturing injuries being rare. Vascular injury is less common compared to ductal injuries.

Diagnosis and Investigations :

Investigative work up of bile duct injuries are directed by clinical manifestations :-

Bile leaks usually presents early, manifested by increased drain output, fever, peritonitis, abscess or sepsis. Hyperbilirubinaemia may be present due to reabsorption of extravasated bile.

Strictures / Occlusive type injuries usually present late in post operative period about 2-3 weeks in an average and is manifested by fever, cholangitis with rising bilirubin which makes diagnosis obvious.

Blood tests :

Rising serum bilirubin and liver enzymes direct as to the possibility of bile duct injury and is indispensable in management of bile duct injury and its follow up.

Ultrasonography :

Always the initial investigation. It can detect fluid collection, abscess, bilioma in leaking type of an injury, whereas presence of dilated intrahepatic biliary radicles and major ducts point to

occlusive / stricturing injuries. Percutaneous aspiration of collection can be done under ultrasonic guidance.

Disadvantages are

- Operator dependant
- Does not guide the management option as exact pathology is not identified.

***Computerized tomography*:**

Contrast enhanced computerized tomography is better than ultrasonogram as it can fairly detect the level of obstruction and gives surgeon a preoperative picture. Still with this modality exact length of stricture cannot be identified and it cannot reliably diagnose ongoing leak.

Scintigraphy :

HIDA scan can reliably detect on going leaks and presence of biliary discontinuity inferred from failure of radionuclide to enter the duodenum, but cannot provide exact anatomical details of the lesion.

ERCP :(Endoscopic retrograde cholangiopancreaticography)

This is preferred diagnostic modality still in many centers where non operative management in the form of intraluminal stents is popular. Gives excellent anatomic detail of distal biliary tree can be combined with therapeutic procedure at many instances.

Disadvantage of ERCP are

1. Invasive procedure
2. Does not give information regarding status of proximal ducts and length of stricture which is crucial for deciding type of repair to be under taken.
3. Associated significant incidence of pancreatitis.

***Percutaneous transhepatic cholangiography* :**

When combined with ERCP gives complete anatomical information required. Rarely done nowadays as it is unacceptably invasive.

MRCP (Magnetic Resonance cholangio pancreaticography)

It is fast replacing ERCP for preoperative classification of bile duct injuries / strictures. It is non invasive, delineates both proximal and distal duct anatomy which makes deciding the surgical repair easy.

Cost, though is still a limiting factor for its use in developing countries.

Management Options

Injury identified during laparoscopic cholecystectomy

Partial tears of CBD can be closed over a T-tube and managed as usual. This can be done either as open procedure or laparoscopically.

Major injuries when detected should be converted to open. Depending on the length of the extra hepatic bile duct available, one of the following procedure can be undertaken.

- Roux – en – Y Hepatico jejunostomy
- Roux – en – Y choledocho jejunostomy

Endoscopic Techniques :

A) Endoscopic biliary Drainage : Transduodenal drainage of biliary tree is method of choice in patient with leakage from cystic duct and in selected patients with minor leakage from the common duct. Drainage may be accomplished using a nasobiliary stent or an indwelling stent with or without papillotomy.

b) Endoscopic Dilatation : A guide wire is passed through the area of stricture and the stricture is dilated with balloon. Stents are frequently placed.

***Percutaneous Techniques* :**

These technique requires transhepatic approach (PTC) with passage of guide wire through the stricture. Dilators of increasing size are then passed through the stricture. A percutaneous catheter is routinely left in these patient to minimize chances of leakage of bile into the sub hepatic space, to reduce the sepsis and to permit future dilatation and cholangiography.

Open techniques :

Usually a form of biliary enteric anastamosis decided by site of injury / stricture and length of extrahepatic biliary duct available. These are:

Intrahepatic cholangio jejunostomy : (Segmental drainage)

Done in case of frozen hilum where the ducts could not be isolated in high injuries. Segmental duct draining segment III or V is anastamosed to Roux loop of jejunum.

Hepatico duodenostomy :

Done where Roux-loop is not feasible. Anastamosis is done in end to side manner. This anastamosis is accessible to endoscopic instrumentation.

Roux-en-Y Hepatico Jejunostomy / choledochojejunostomy :

This is usually the procedure of choice for major transectional and stricturing injuries, can be used with internal stents to avoid anastamotic site strictures.

Methylene Blue Dye Injection to prevent Bile Duct Injuries

Introduction :

Injection of methylene blue is not new to practice of surgery, frequently used to trace sinus or fistula during various procedures, sentinel lymph node biopsy and in chromointubation (Tube patency test). In this study Methylene blue is used to delineate extrahepatic biliary tract including Gall bladder during laparoscopic cholecystectomy by coloring them blue.

It's a novel approach with largest series of 46 cases performed in Istanbul Training Hospital, Istanbul. Basic purpose of this technique is to facilitate young surgeons / residents in beginning of their learning curve to execute a SAFE cholecystectomy and to help dissections in 'Difficult cholecystectomies'.

Method :

Gall bladder fundus was punctured by Verress needle and all the bile was aspirated. The same amount of 50% methylene blue (saline diluted) was injected into the gall bladder for coloration of biliary tree ie. gall bladder, cystic duct, bile duct and some times duodenum. The puncture site was held through out the operation

with toothed grasper through the lateral subcostal port. Gall bladder was removed by subxiphoid port. Methylene blue is aspirated to prevent leak while removal of Gall bladder.

Post operative consideration :

- Patient must be informed that urine may colored blue, as the dye which leaks to duodenum is absorbed and excreted through kidney.
- Ryle`s tube aspirate may be colored blue either intra operatively or post operatively. Confirming patency of common bile duct.

Advantages of Methylene blue injection :

- Safer & faster dissection in Calot`s triangle
- Detection of aberrant anatomy of biliary tract
- To detect bile duct injury (if it does occur) per operatively and enables its repair in the same sitting hence decreasing morbidity of unrecognized bile duct injuries.
- Can supplement Intraoperative Cholangiogram (IOC) interpretation per operatively as it orients surgeon to IOC findings.
- Cost effective, negligible adverse effects and does not prolong operative time.

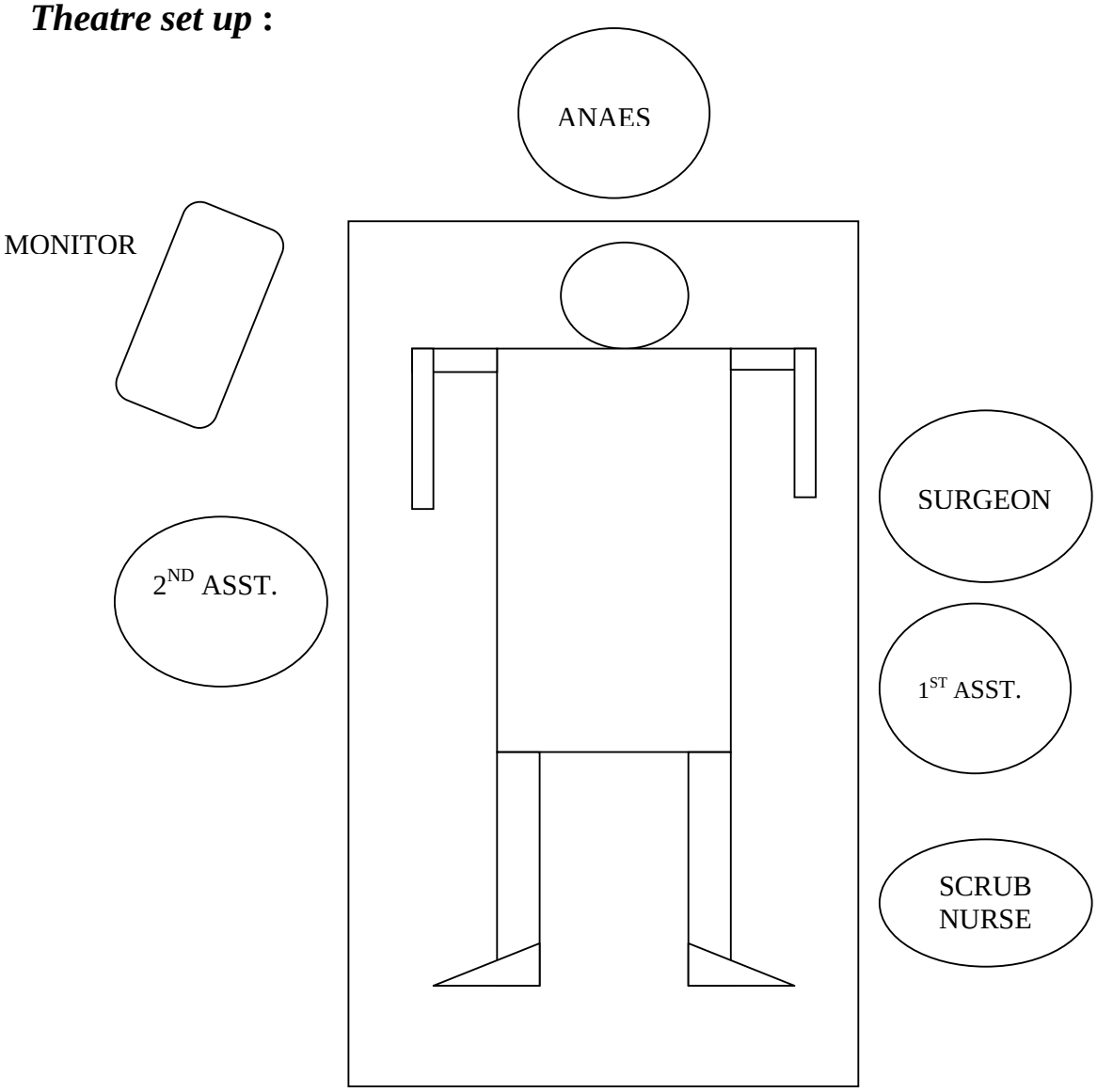
Disadvantages : Spillage early during the procedure can obscure field of operation

Technique of Safe Laparoscopic cholecystectomy

***Positioning of the patient* :**

Anti Trendlenberg's position with 30 degree lateral tilt towards left is desired as is it clears the operative field of small bowel loops, stomach and transverse colon due to gravity.

***Theatre set up* :**



Operative team set up is as shown in figure. It doesn't require patient to be placed in Lloyd Davis position as in French set up, but many surgeons feel less comfortable due less available space.

***Access* :**

Pneumoperitoneum is created by OPEN / HASSON'S TECHNIQUE. A curvilinear supra umbilical incision is placed about 1-1.5 cm in length. Peritoneum is opened through the incision and entry into abdominal cavity is confirmed. A 10 mm Cannula with or without blunt tipped Hasson's Trocar is introduced which should snugly fit to prevent gas leak. Open technique has the advantage of quick access and quick pneumoperitoneum creation.

Veress needle technique or closed technique bears the risk of bowel or vascular injury, takes more time to reach the desired level of pressure (12 mm of mercury) needs patient to be placed in head down position.

After creation of pneumoperitoneum and routine visual inspection of abdominal cavity, a second 10 mm port is placed 2/3rd of the way between umbilicus and the xiphisternum to the right of

the midline. A 5 mm cannula is inserted 3-4 cm below the costal margin in the mid clavicular line and a second 5 mm cannula is inserted 4-5 cm below the costal margin in the anterior axillary line. Position can be adjusted as per the need of the surgery.

The supra umbilical 10 mm port is used for the 0 or 30 degree telescope and for CO2 insufflation. Sub xiphoid port is used for dissection with surgeon right hand, whereas the other two 5 mm ports are used for retraction at the fundus (Ant. axillary line) and at the infundibulum (Mid clavicular line)

A 30 degree telescope has the advantage of providing over head view of the field similar to an open surgery.

Gall bladder fundus is grasped and retracted cephalad to expose the sub hepatic area and the infundibulum of the gall bladder. With the mid clavicular line port, infundibulum is grasped and retracted laterally and inferiorly to lay open the Calot`s triangle and it creates a distinct angle between the cystic duct and common bile duct and hence avoiding their alignment in one line which is forerunner of the diaster seen in ‘classical injury’ as shown.

On adequate exposure of Calot`s triangle the dissection should commence high on the gall bladder initially posteriorly and then anteriorly. One should visualize the '**posterior peritoneum'** covering the '**yellow pad of fat'** and keep the dissection just above it.

As one proceeds inferiorly cystic duct is encountered. Junction of cystic duct with gall bladder is visible as '**Elephant head'** or '**The Ganesha sign'** which is a must see during laparoscopic cholecystectomy to avoid injury. At times, there may be an anteriorly placed cystic artery which has to be divided to proceed further.

Next step is to create a 'Critical window' in the Calot`s triangle which clearly demonstrate the cystic artery and the duct in loose areolar tissue which bridges the Calot's triangle. Dissection should not proceed beyond '**Rouvier's sulcus'** which is the only constant landmark in this area and marks the lateral extent of porta hepatis hence helps to avoid high bile duct injury.

If cholangiography is planned, it is to be done at this stage by introducing cholangio catheter via a small opening in cystic duct after placing a clip distally at its junction with gall bladder. Contrast is injected to delineate the biliary tree under fluoroscopic guidance. Though it prevents bile duct injury during further procedure, it cannot prevent injuries which are sustained during dissection described before.

If the anatomy is clear, cystic artery is doubly clipped proximally and also distally and divided followed by division of cystic duct between double clips, maintaining the lateral traction. At times larger branches of cystic arteries may have to be ligated or clipped.

An abnormally large cystic artery may suggest the presence of ‘Caterpillar hump’ right hepatic artery. If it is present the right hepatic artery should be dissected away and clipping the cystic artery which usually arises from angled hump of right hepatic artery. Avulsion of cystic artery should be avoided here.

Any haemorrhage should be controlled by compression with adjacent bowel, gauze piece and is accurately identified and ligated or clipped. Blind and desperate attempts to control bleeding, leads to disaster.

Dissection of GB from liver bed should not be callous and as one might miss aberrant cysto-hepatic duct which may cause post operative biliary leak. Dissection is done with scissors or cautery. Gall bladder is removed from abdominal cavity as such or in an endo bag or condom carefully, or bile may evacuated from Gall bladder to ease its manipulation during delivery.

Presence of overriding Hartmann's pouch adherent to common bile duct should raise the possibility of 'Mirizzi syndrome' with cholecysto biliary fistula which is usually a strong contraindication laparoscopic procedure.

In acute cholecystitis planes may not be as clear as in chronic cases and moreover, tissue may be friable. Dissection is as for other

procedure, sharp dissection is used, preferably with scissors. Conversion to open procedure should be strongly considered.

In case of short cystic duct where clips cannot be applied without avoiding lateral wall of CBD, a ligature may be applied avoiding CBD wall or else conversion to open is a better option.

CBD should not be dissected to display its junction with cystic duct as it carries increased chances of injuries.

A suction or tube drain of size 14 is placed in sub hepatic area to detect bile leak. Pneumoperitoneum is let out and port sites are closed.

CONCLUSION

- Incidence of bile duct injury is apparently more in open cases than in laparoscopic cholecystectomy.

- Lower incidence in laparoscopic approach as contradictory to the standard literature statistics probably due to better surgical experience, technique of modern day surgeons, improved visual aids and laparoscopic instruments. However, larger sample size is required to show the statistical significance of this study.

- Obesity, Number and duration of attacks, acute onset and previous upper abdominal surgeries were reliable pre operative predictive factors for ‘Difficult cholecystectomy’. Whereas age and sex did not show any difference.

- Laparoscopic approach has clear advantage over open approach with regards to other complications also.

- Methylene blue dye injection is an excellent, simple, cost effective technique to aid surgeons in beginning of their learning curve to execute a safe laparoscopic cholecystectomy and to aid dissection in difficult cholecystectomy.

- MRCP followed by biliary enteric anastamosis and has provided symptom free solution for the major bile duct injury in our follow up of one case of major bile duct injury.

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PROFORMA

Name : Age : Sex :

Address : Occupation : DOS :

Weight : Height :

BMI

Complaints :

Pain Abdomen / Fever / Dyspepsia / Others

Duration of pain abdomen / No.of attacks

Medical Treatment (Specific / Non specific) : Yes / No

Comorbid Illness :

DM / HTN / Restrictive or obstructive lung disease/ CRF / CAD

Previous Surgery :

Vagotomy / Gastrectomy / Devascularisation / Others

Physical Examination : Vitals

Anaemia Jaundice Pedal Edema

Generalised lymphadenopathy

P/A : Inspection

Contour - Flat /Scaphoid / Distended

Previous scar - Yes / No

Any obvious Mass - Yes / No

Palpation :

Tenderness / Murphy's sign):Yes / No

Mass if any : Yes / No

Others systems :

CVS / RS / CNS

Diagnosis : Acute / Chronic

Specific Investigations :

1. Routine
2. LFT = Normal / Abnormal parameter
3. BT / CT = Normal / Increased
4. USG : Yes / No
5. CT Abdomen : Yes / No
6. OGD
7. MRCP / ERCP : Yes / No

Mode of Treatment :

Open cholecystectomy / Lap. cholycystectomy / Lap. Converted to open

Whether Lap converted to open

If so, (reason why) : Bleeding / Extensive Adhesions /

Anaesthetic / Indescernible Anatomy / Others

Anaesthesia : GA / Epidural / Spinal

Incision (If open) : Kocher's / Midline / Others

Approach (if lap) : 10 mm I
II
5 mm I
II
III

Technique :

Cystic duct first

Fundus first

Methylene Blue Injections - Given / Not given

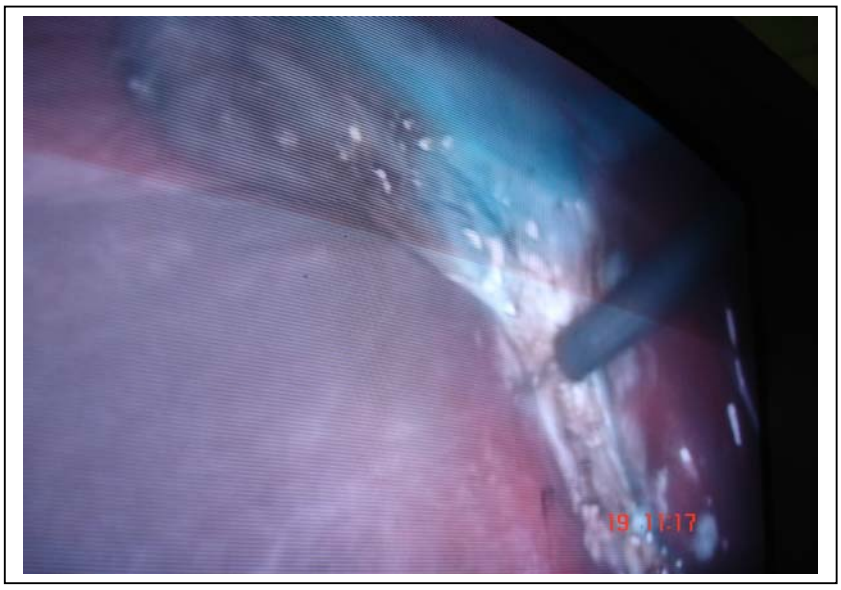
Operative time in minutes :

Surgeon's Experience : < 10 / 10-20 / > 10 cases

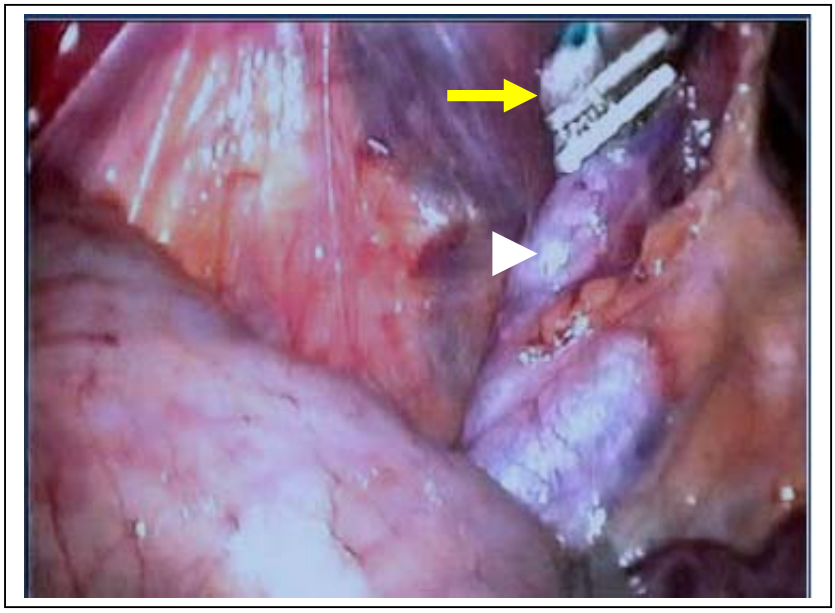
Complication : Wound infection
Wound dehiscence
Minor bile duct injury
Major bile duct injury
Resp. infection
Port site hernia / Incisional hernia

Further Interventions : Yes / No

DISSECTION OF GALL BLADDER FROM THE LIVER BED

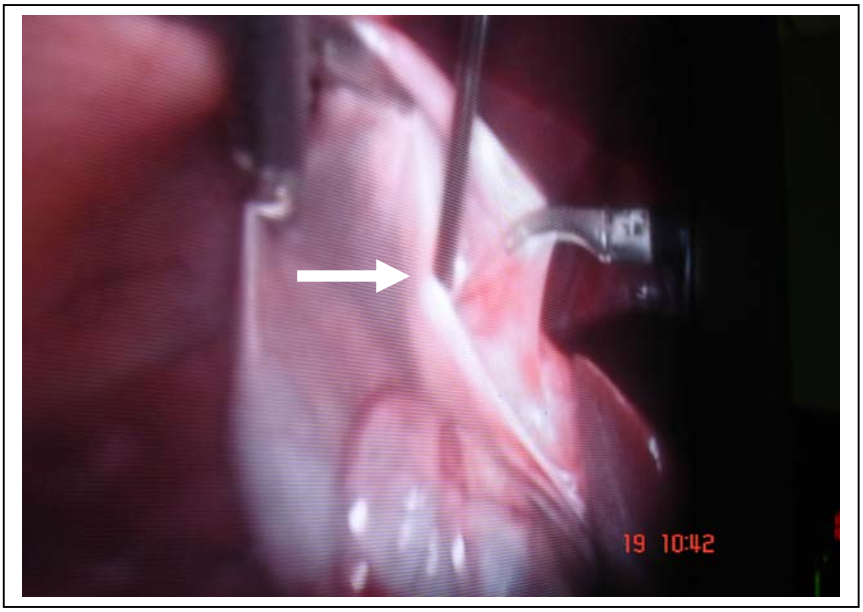


CYSTIC STUMP AFTER COMPLETION OF CHOLECYSTECTOMY (NOTE THE BLUE DYE IN THE LUMEN) CBD (ARROW HEAD)



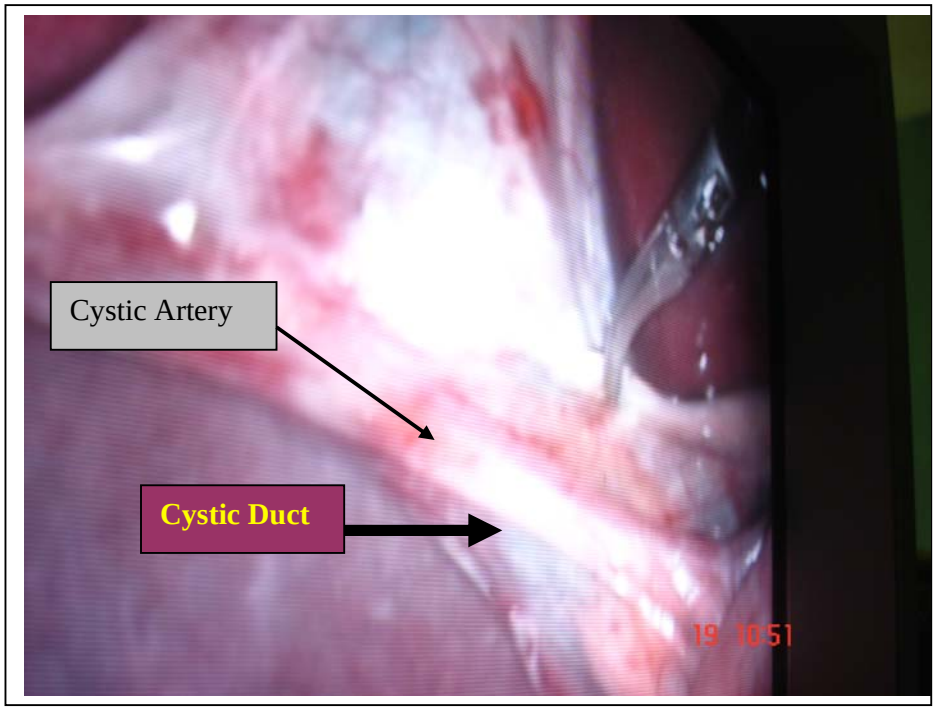
INJECTION OF METHYLENE BLUE DYE INTO

FUNDUS OF GALL BLADDER

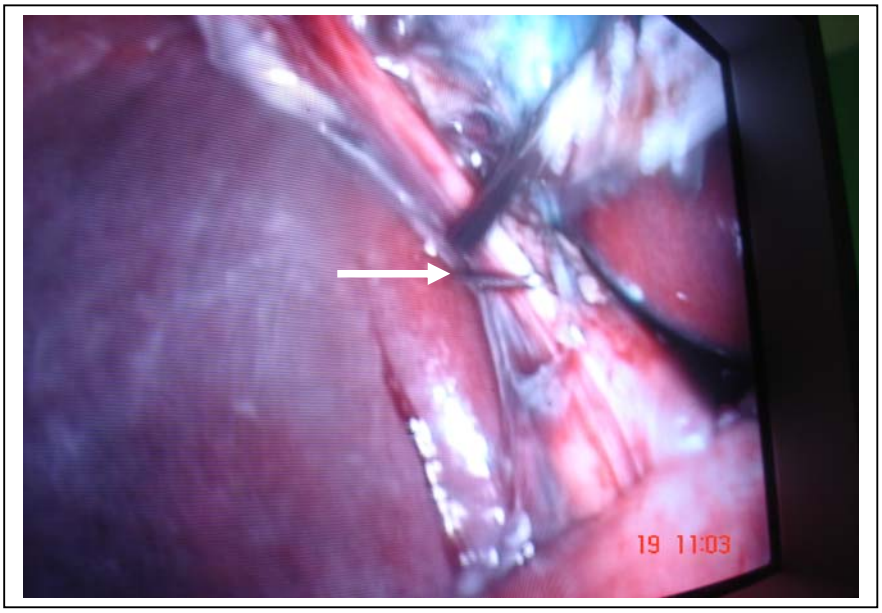


COLOURING OF GB WITH METHYLENE BLUE

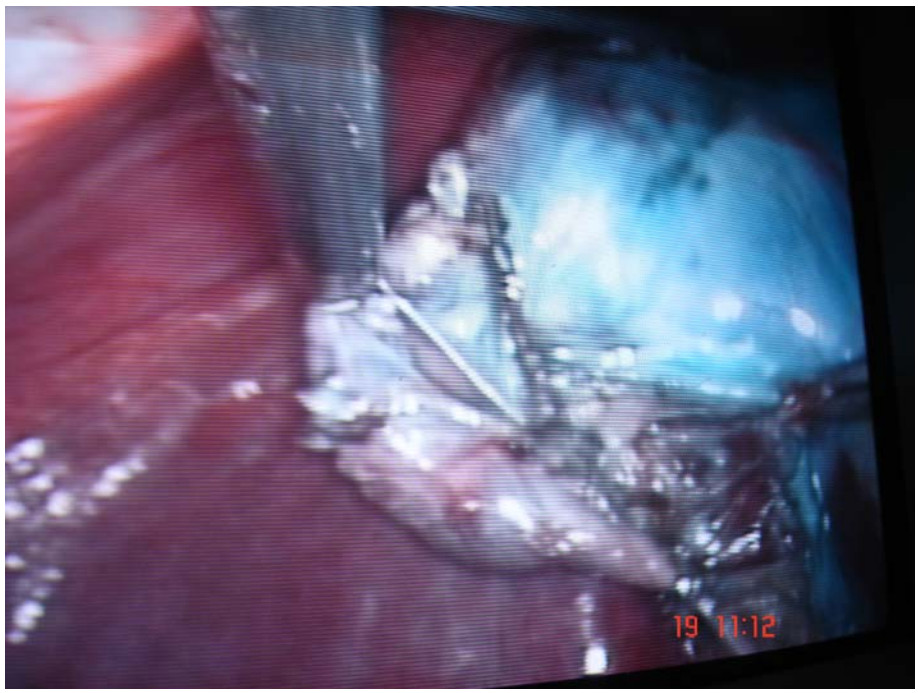
DISSECTION OF CALOT'S TRIANGLE WITH
LATERAL TRACTION
(CYSTIC DUCT COLOURED FAINT BLUE WITH DYE)



CLIPPING OF CYSTIC ARTERY



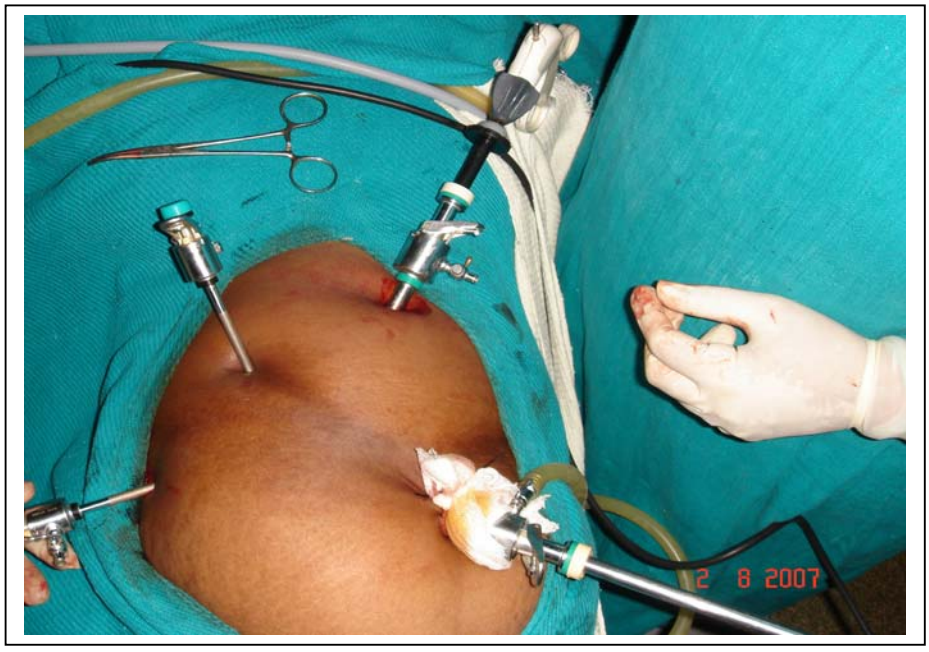
AFTER DIVISION OF CYSTIC ARTERY – JUNCTION OF CYSTIC DUCT WITH GALL BLADDER CLEARLY VISIBLE



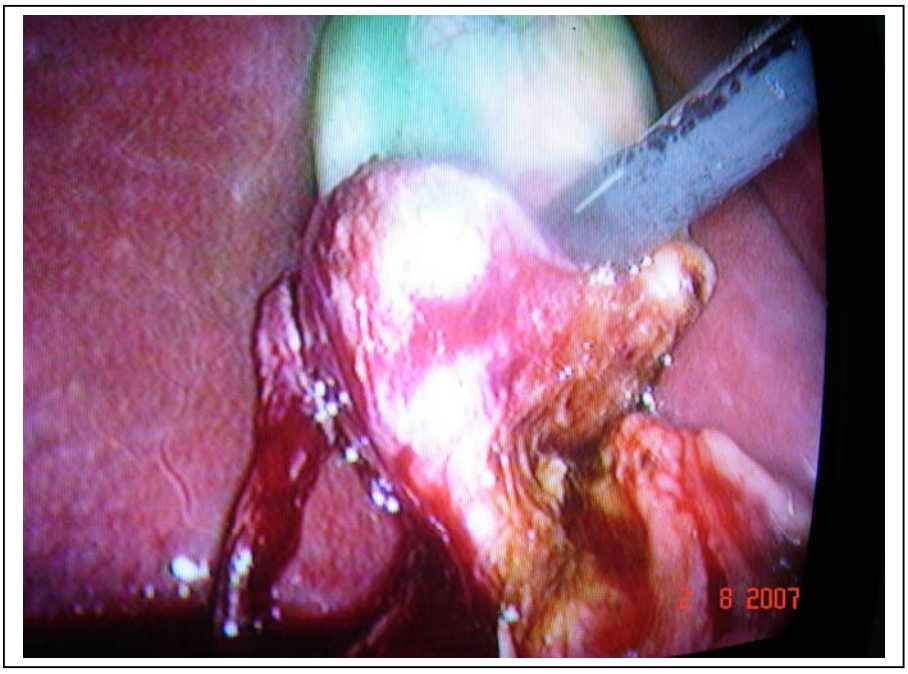
OPEN / HASSON'S TECHNIQUE FOR CREATING PNEUMOPERITONEUM

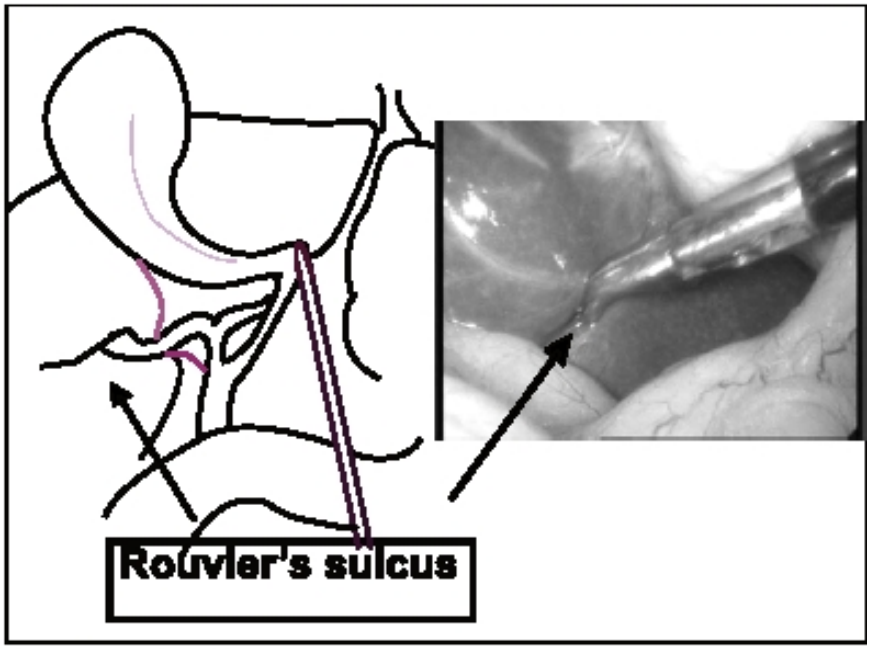
INTRODUCTION OF CAMERA PORT (10 MM)

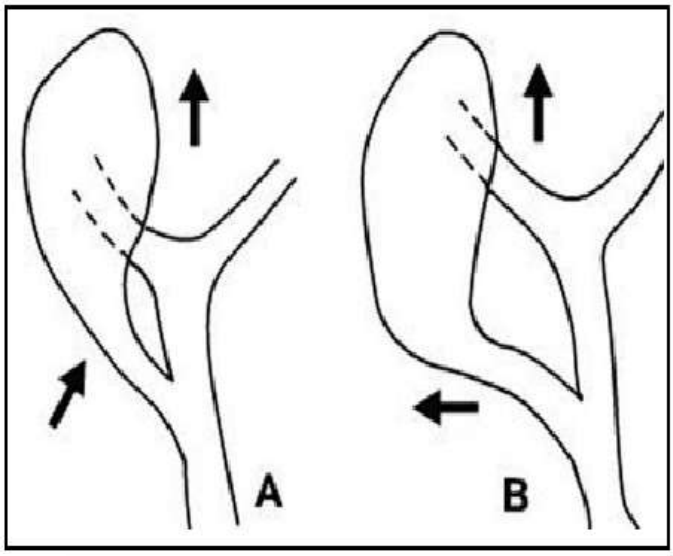
AFTER PLACEMENT OF ALL THE PORTS



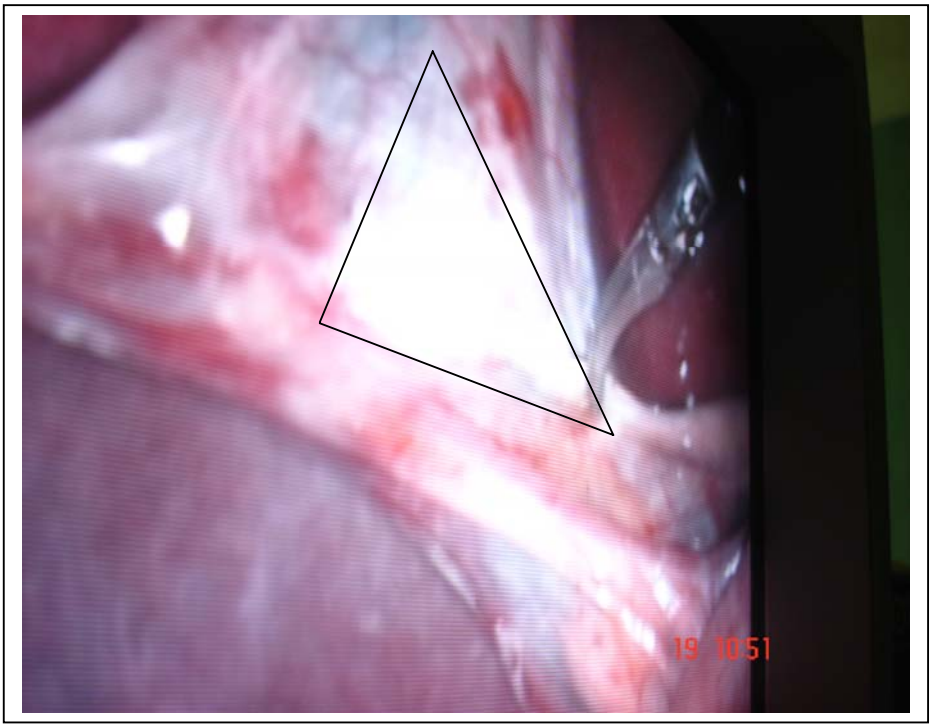
ELEPHANT HEAD OR GANESHA SIGN







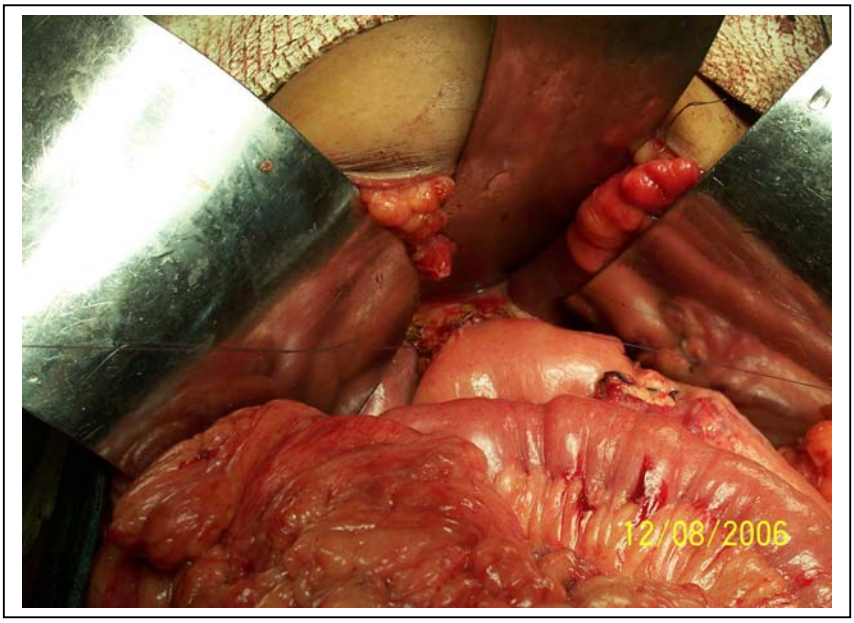
Shows the faulty anterior and medial traction on the Hartman's pouch (A), and the correct lateral and inferior traction(B) to open up the angle between the CD and CHD

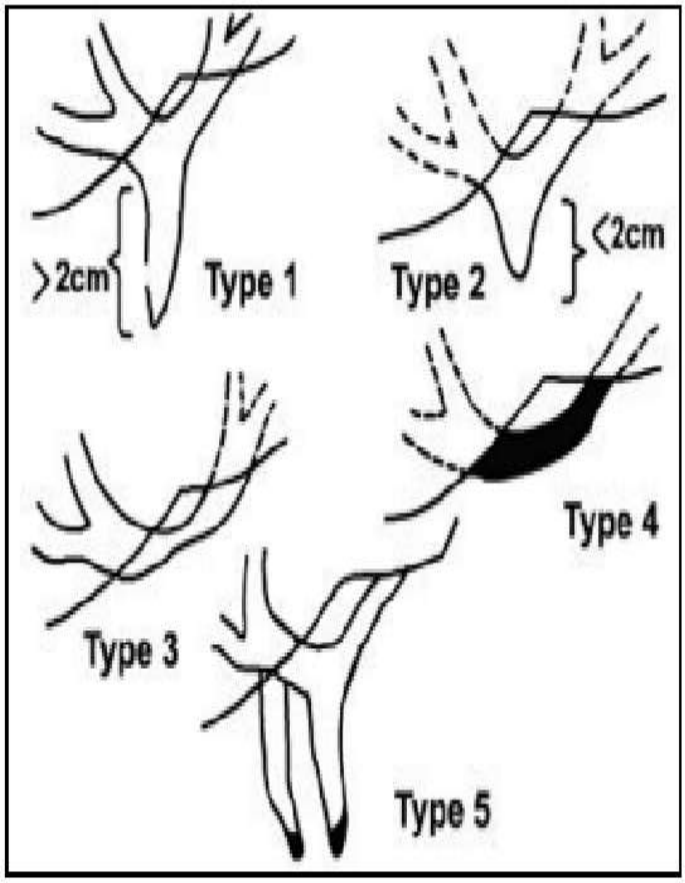


DISPLAY OF CALOT'S TRIANGLE BY LATERAL TRACTION

BILIOMA FOLLOWING MAJOR BILE DUCT INJURY IN OPEN CHOLECYSTECTOMY

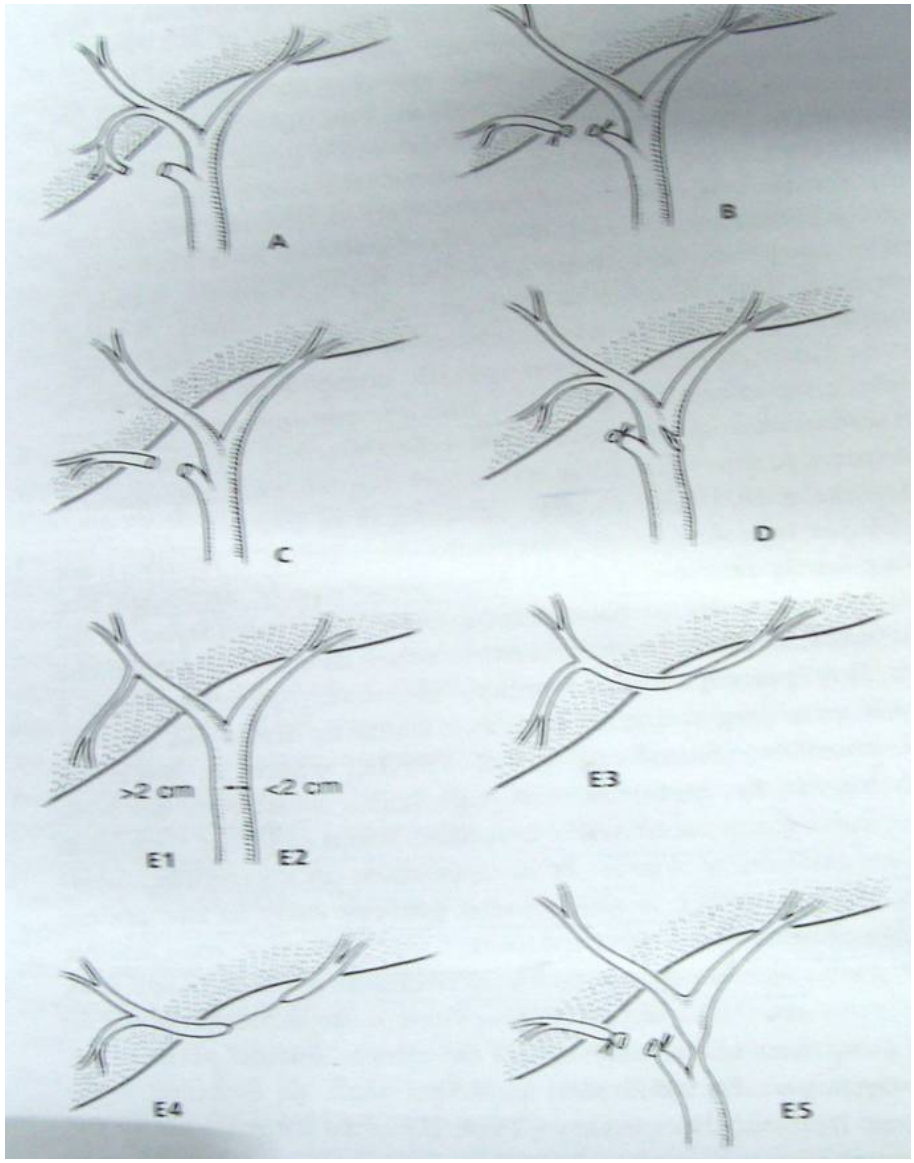
RECONSTRUCTION WITH ROUX-EN-Y HEPTICO JEJUNOSTOMY (AFTER 1 YEAR)



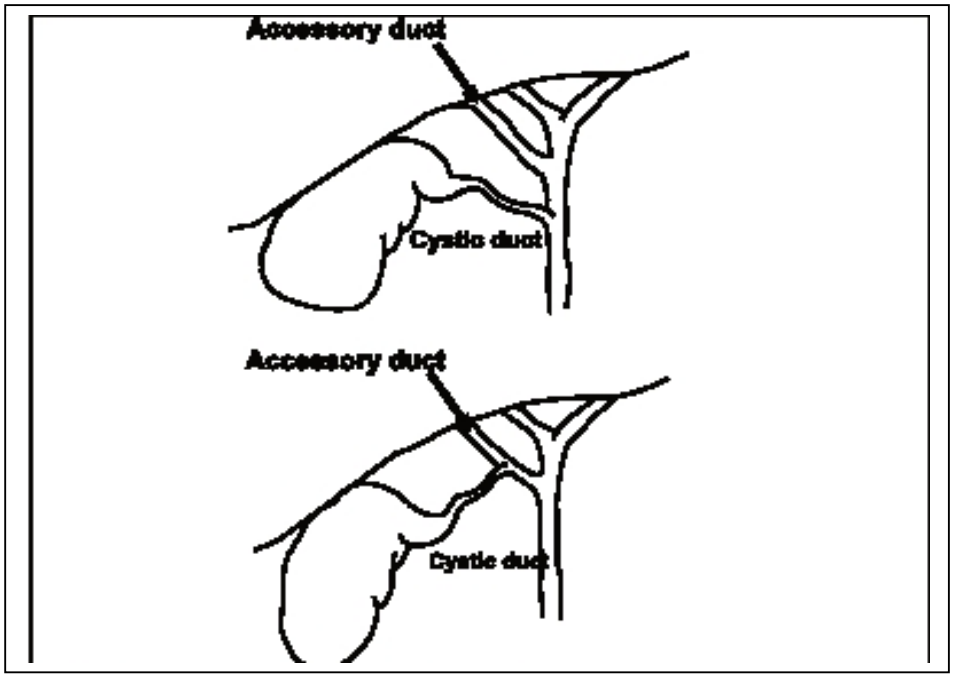


Shows Bismuth Type 1 to Type 5 biliary strictures (same as Type E1 to E5 of Strasberg classification)

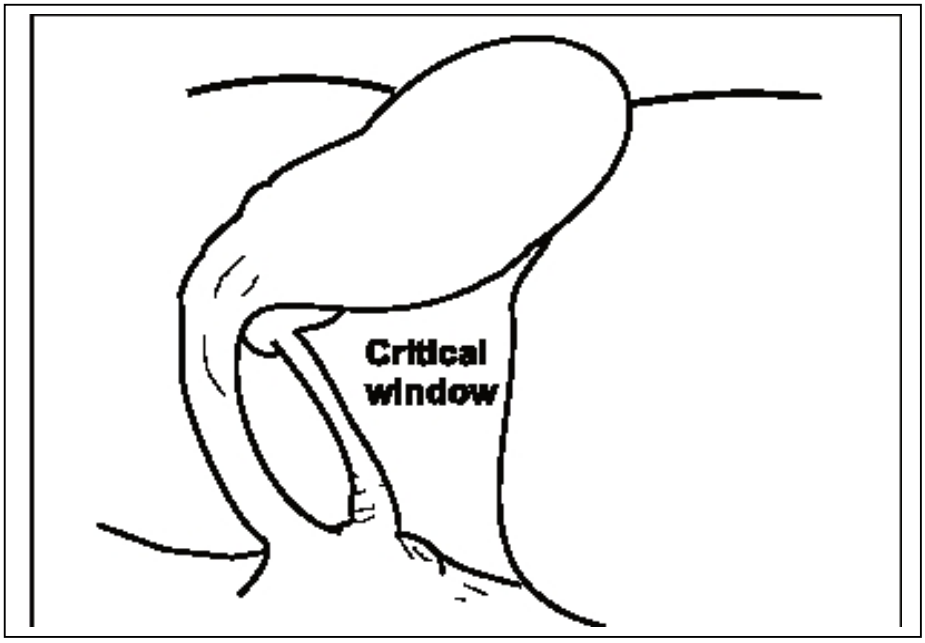
STRASSBERG CLASSIFICATION OF BILE DUCT INJURIES

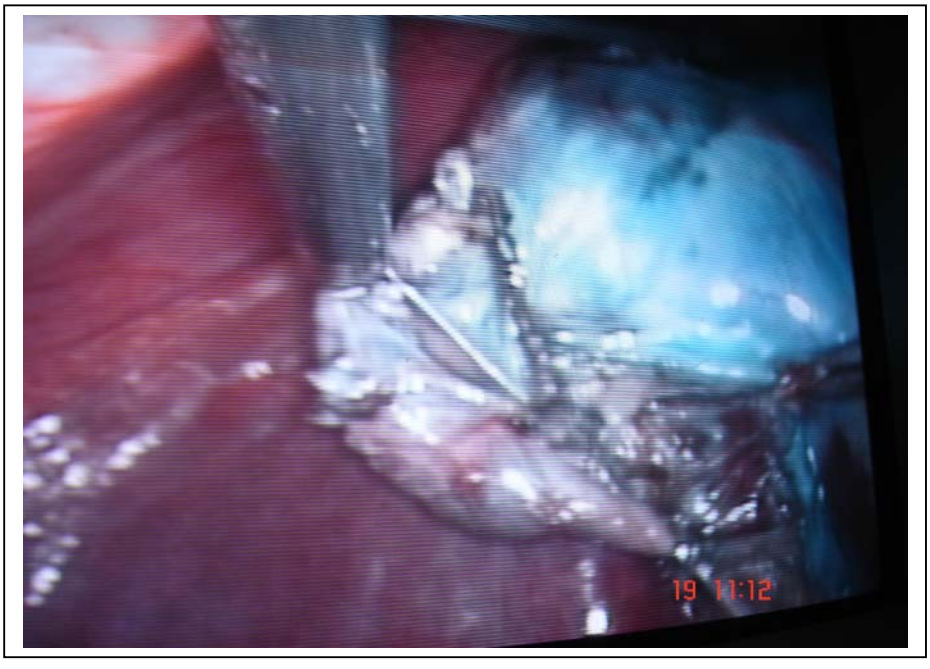


ANOMALOUS BILE DUCTS RELEVANT TO CHOLECYSTECTOMY



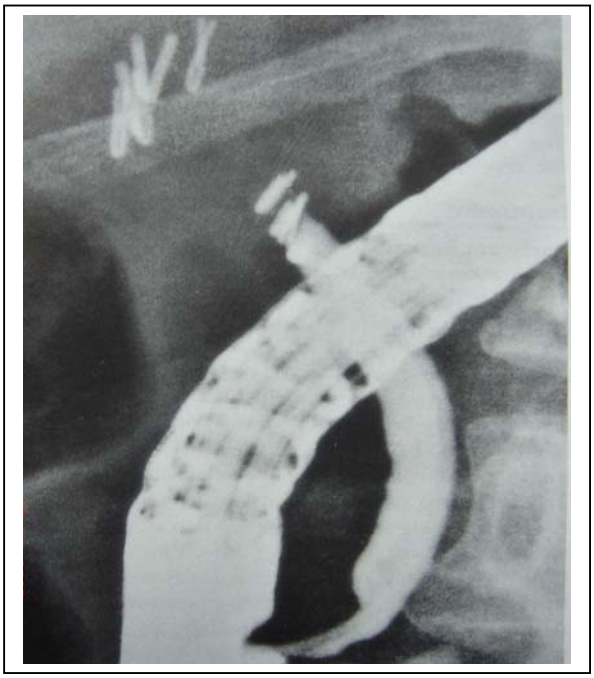
CRITICAL VIEW OR SAFETY WINDOW

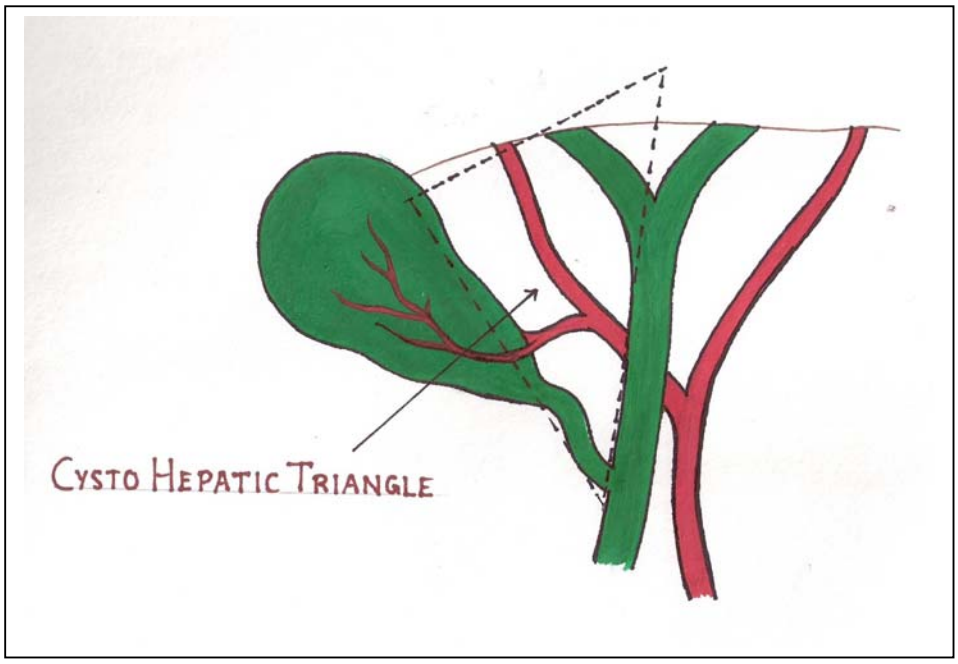


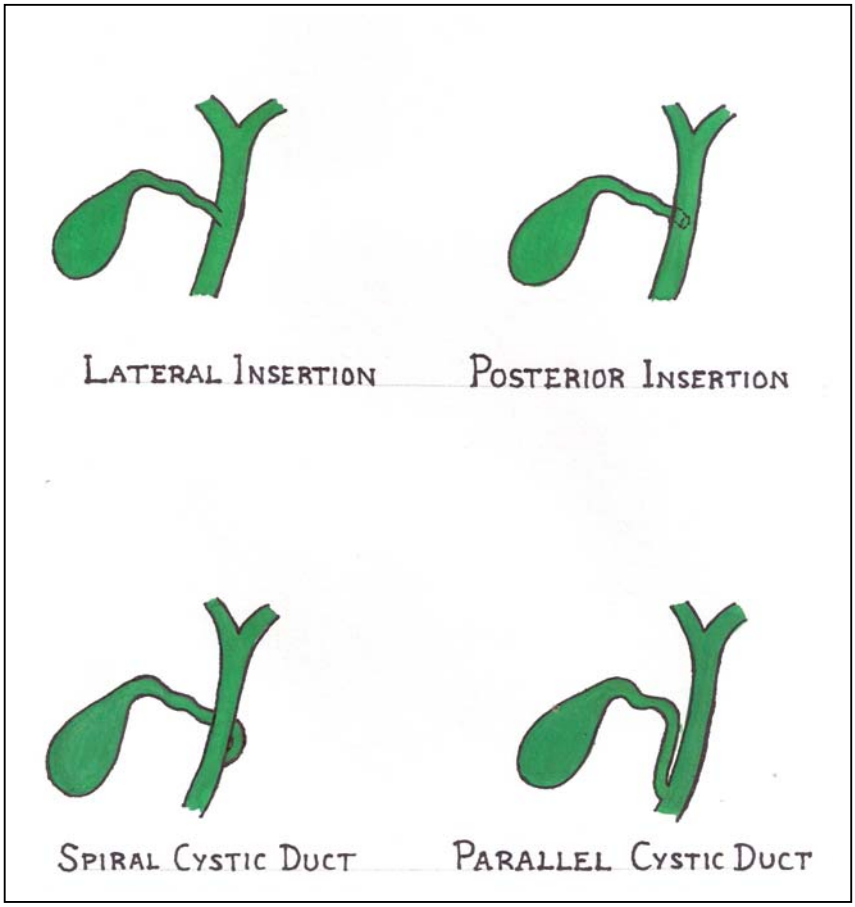


MRCP PICTURE OF TYPE E
STRASSBERG BILE DUCT INJURY

ERCP PICTURES OF TYPE E STRASSBERG
BILE DUCT INJURY

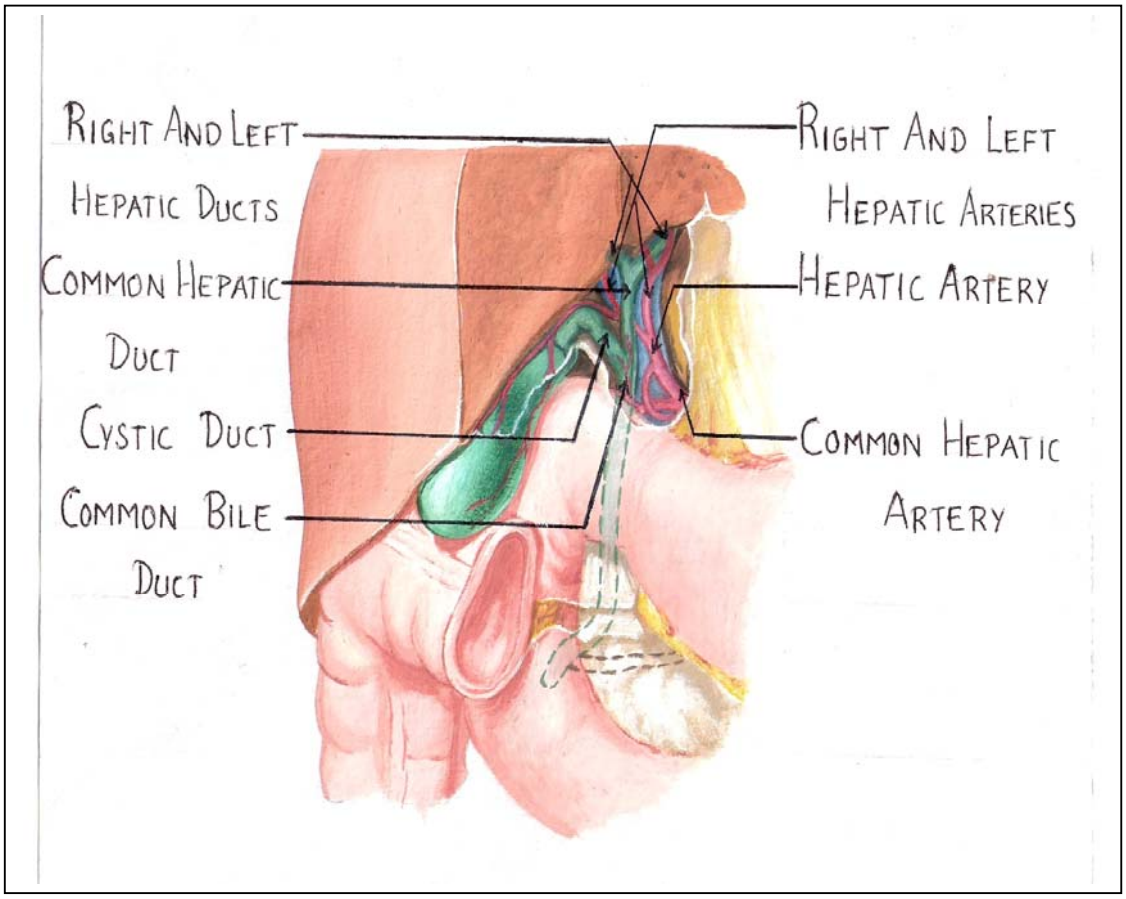




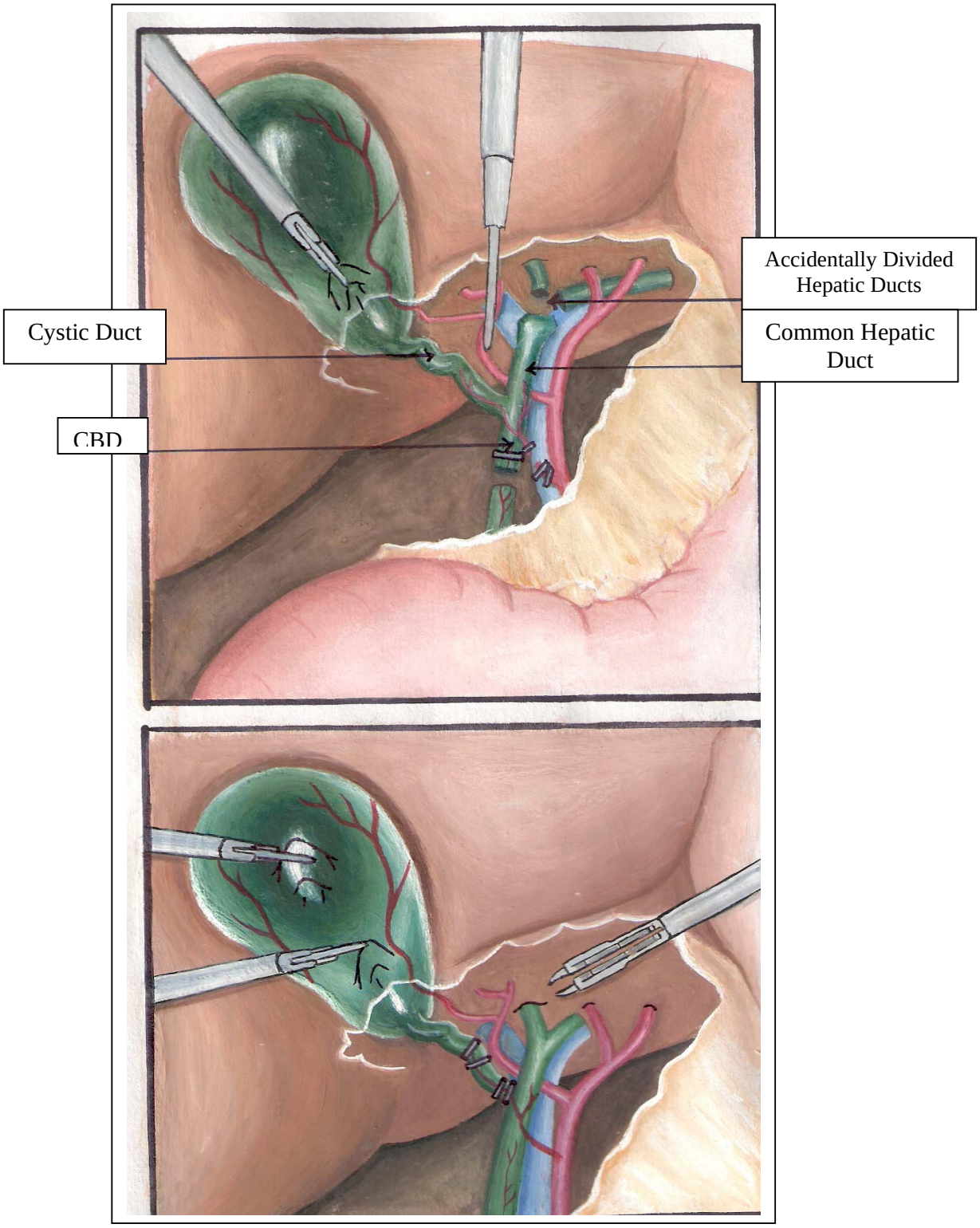


VARIATION IN CYSTIC DUCT TERMINATION

ANATOMY OF THE REGION

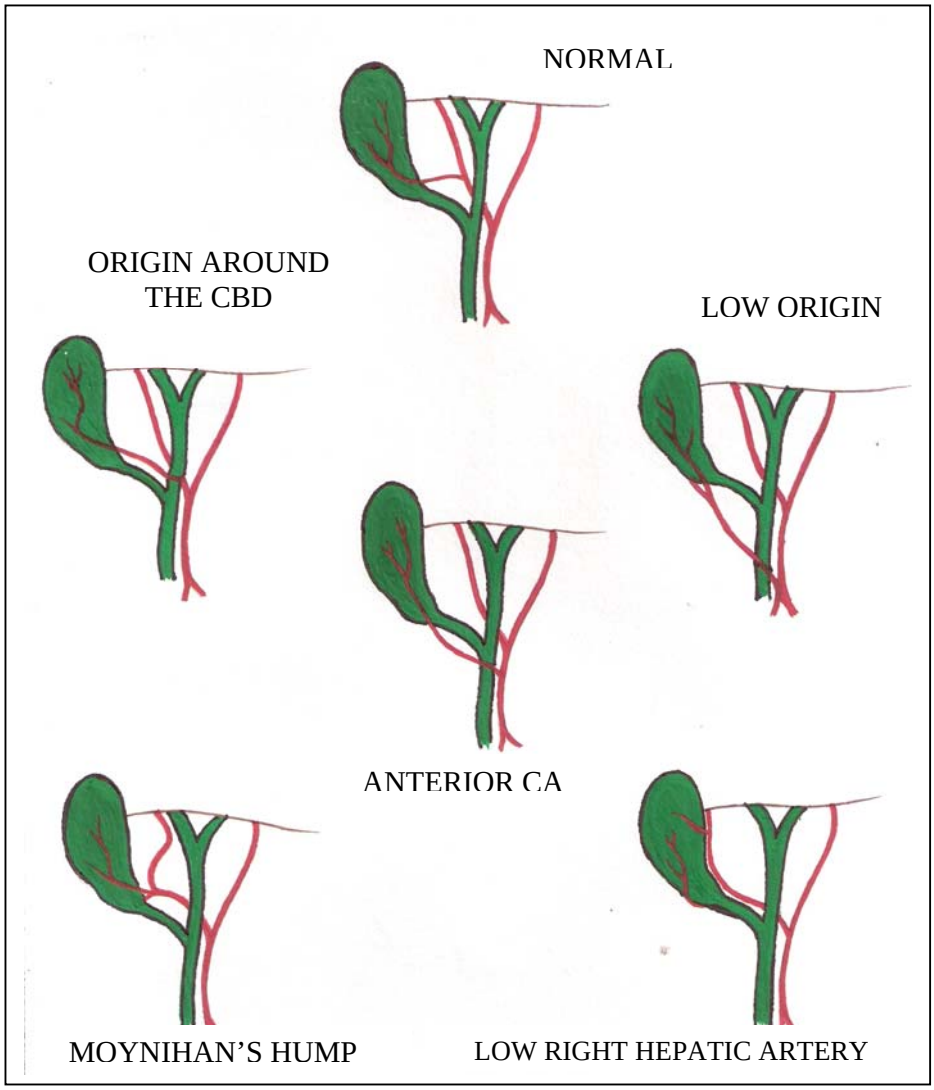


CLASSICAL LAPAROSCOPIC INJURY TO CBD



PROPER PLACEMENT OF CLIPS

VARIATION IN CYSTIC ARTERY ANATOMY



CONCLUSION

MASTER CHART

Sl. No	Name	Age / sex	Month of surgery	Body Mass Index	Symptoms			Previous U. ABD surgery	Diagnosis		Investigations								
					Pain abdomen		Others		Acute	Chronic	LFT			USG			OGD	CT- Abdomen	MRCP
					Duration (in months)	No. of attacks					Bilirubin	ALP	Others	Gall stones	GB wall thickness	CBD			
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
1.	Devanai	60/F	7/05	30	6	2	√	-	-	√	N	N	-	+	↑	N	N	-	-
2.	Anjammal	28/F	7/05	29	7	8	-	-	-	√	N	N	-	+	↑	N	N	-	-
3.	Maheshwari	45/F	8/05	30	2days	1	√	-	√	-	N	↑	-	+	↑	N	N	√	Yes
4.	Pramila	48/F	8/05	31	2	3	-	-	-	√	N	N	-	+	↑	N	N	-	-
5.	Guruvammal	50/F	8/05	29	4	2	-	-	-	√	N	N	-	+	↑	N	N	-	-
6.	Soundarajan	67/M	8/05	28	1	2	-	-	-	√	N	N	-	+	N	N	N	-	-
7.	Natchiammal	60/F	9/05	31	3	4	√	-	-	√	N	N	-	+	↑	N	N	-	-
8.	Vallaimmal	55/F	9/05	24	4	2	√	yes	-	√	N	N	-	+	N	N	N	-	-
9.	Paulraj	60/M	9/05	31.1	5	8	-	-	-	√	N	N	-	+	↑	N	N	-	-
10.	Fathima	24/F	9/05	28.9	3	3	-	-	-	√	N	N	-	+	↑	N	N	-	-
11	Udaiyar	29/M	10/05	26	1	2	-	-	-	√	N	N	-	+	↑	N	N	-	-
12	Kannaiah	75/M	10/05	26.2	6	7	-	-	-	√	N	N	-	+	↑	N	N	-	-
13	Sherine	42/F	10/05	27	6	6	-	-	-	√	N	N	-	+	N	N	N	-	-
14	Ramu	80/M	11/05	29	7	8	√	-	-	√	N	N	↓ALB	+	↑	N	CHR DU	-	-
15	Rani	51/F	11/05	31	3	3	-	-	-	√	N	N	-	+	↑	N	N	-	-
16	Saminathan	55/M	12/05	33.3	5	3	√	-	-	√	N	N	-	+	↑	N	N	-	-
17	Mamoon	65/M	12/05	30	6	3	-	-	-	√	N	N	-	+	↑	N	N	-	-
18	Selvi	38/F	12/05	26	2	5	√	-	-	√	N	↑	-	+	N	N	N	√	-
19	Arun kumar	16/M	1/06	25	4	4	√	-	-	√	N	N	-	+	N	N	N	-	-
20	Pichaiammal	43/F	1/06	31	2	3	-	-	-	√	N	N	-	+	↑	N	N	-	-
21	Brunda	70/F	2/06	29	2	2	-	-	-	√	N	N	-	+	↑	N	N	-	-
22	Gandhi	61/M	2/06	27	3	3	-	-	-	√	N	N	-	+	↑	N	N	-	-
23	Latha	37/F	2/06	25	4	5	√	-	-	√	N	N	-	+	↑	N	N	-	-
24	Sameera	51/F	3/06	30	5	7	√	-	-	√	N	N	-	+	N	N	N	-	-
25	Rajagopal	45/M	4/06	29.3	6	4	-	-	-	√	N	N	-	+	N	N	N	-	-
26	Jamruth Nisha	35/F	4/06	33	2days	1	√	-	√	-	N	N	-	+	↑	N	N	-	-
27	Sundrammal	60/F	5/06	26	5	3	-	-	-	√	N	N	-	+	N	N	N	-	-
28	Indira	52/F	6/06	28	7	6	-	-	-	√	N	N	-	+	↑	N	N	-	-
29	Gnanasekaran	38/M	6/06	26	8	7	√	-	-	√	N	N	-	+	↑	N	N	-	-
30	Palanichamy	40/M	6/06	31	3	2	-	-	-	√	N	N	-	+	↑	N	N	-	-
31	Muthusamy	60/M	7/06	31	2	6	√	-	-	√	N	N	-	+	↑	N	N	-	-
32	Ameena beevi	51/F	7/06	32	1	2	-	-	-	√	N	N	-	+	↑	N	N	-	-
33	Subramaniam	45/M	8/06	28	8	9	-	-	-	√	N	N	-	+	↑	N	N	-	-
34	Annalakshmi	50/F	10/06	27.3	2	3	√	-	-	√	N	N	-	+	N	N	N	-	-
35	Thottichi	32/F	10/06	29	12	10	-	-	-	√	N	N	-	+	N	N	N	-	-
36	Sheela	40/F	10/06	32.2	8	6	-	-	-	√	N	N	-	+	↑	N	N	-	-

Sl. No	Name	Age / sex	Month of surgery	Body Mass Index	Symptoms			Previous U. ABD surgery	Diagnosis		Investigations								
					Pain abdomen		Others		Acute	Chronic	LFT			USG			OGD	CT- Abdomen	MRCP
					Duration (in months)	No. of attacks					Bilirubin	ALP	Others	Gall stones	GB wall thickness	CBD			
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
37	Chitra devi	36/F	11/06	31.1	9	10	√	-	-	√	N	N	-	+	↑	N	N	-	-
38	Muniyammal	44/F	11/06	29.4	10	11	√	-	-	√	N	N	↑ALT	+	↑	N	CHR DU	-	-
39	Chellaih	50/M	12/06	28	4	5	-	-	-	√	N	N	-	+	↑	N	N	-	-
40	Sugumar	19/M	12/06	29.2	3	2	-	-	-	√	N	N	-	+	N	N	N	-	-
41	Anwar ali	60/M	12/06	29.3	4	5	-	-	-	√	N	N	-	+	↑	N	N	-	-
42	Premkumar	38/M	12/06	34	12	10	√	-	-	√	N	N	-	+	↑	N	N	-	-
43	Palaniammal	49/F	1/07	29.5	5	4	-	-	-	√	N	N	-	+	↑	N	N	-	-
44	Lakshmi	37/F	1/07	30	6	4	-	-	-	√	N	N	-	+	N	N	N	-	-
45	Rajammal	40/F	1/07	31	1	2	√	-	-	√	N	N	-	+	N	N	N	-	-
46	Backiam	57/M	2/07	30	2	3	-	-	-	√	N	N	-	+	↑	N	N	-	-
47	Kaliammal	55/F	2/07	33	4	3	-	-	-	√	N	N	-	+	↑	N	N	-	-
48	Kathirmani	35/F	2/07	30	2	3	-	-	-	√	N	N	-	+	↑	N	N	-	-
49	Paulpandi	44/M	2/07	29	7	5	√	-	-	√	N	↑	-	+	N	N	N	√	-
50	Shanmuganathan	22/M	2/07	24.2	3	9	-	-	-	√	N	N	-	+	↑	N	N	-	-
51	Meenakshi	30/F	3/07	27	20	11	√	-	-	√	N	N	-	+	↑	N	N	-	-
52	Dharmapoopathy	59/F	3/07	28.3	2	3	√	-	-	√	N	N	-	+	↑	N	N	-	-
53	Sumathi	33/F	3/07	28.7	4	6	√	-	-	√	N	N	-	+	↑	N	N	-	-
54	Angammal	40/F	4/07	29	9	11	-	-	-	√	N	N	-	+	↑	N	N	-	-
55	Alagumani	48/F	4/07	33.5	2	3	-	-	-	√	N	N	-	+	↑	N	N	-	-
56	Jothi	40/F	4/07	27.8	18	13	√	-	-	√	N	N	-	+	↑	N	N	-	-
57	Pandian	62/M	4/07	29	5	5	√	-	-	√	N	N	-	+	↑	N	CHRDU	-	-
58	Pandiselvi	23/F	4/07	29.8	7	4	-	-	-	√	N	N	-	+	↑	N	N	-	-
59	Valli	55/F	5/07	30	6	8	√	-	-	√	N	N	-	+	↑	N	N	-	-
60	Vellaisamy	72/M	5/07	29.2	8	9	-	-	-	√	N	N	-	+	↑	N	N	-	-
61	Vijaya	27/F	5/07	29.4	7	4	√	-	-	√	N	N	-	+	↑	N	N	-	-
62	Jothi	42/F	6/07	29	7	10	-	-	-	√	N	N	-	+	N	N	N	-	-
63	Muthu	27/F	6/07	25.5	4	5	√	-	-	√	N	N	-	+	↑	N	N	-	-
64	Sulaiman	50/M	6/07	33	4	4	√	-	-	√	N	N	-	+	↑	N	N	-	-
65	Sujatha	34/F	6/07	32.2	3	3	√	-	-	√	N	N	-	+	↑	N	N	-	-
66	Velan	35/M	7/07	31	3	4	-	-	-	√	N	N	-	+	↑	N	N	-	-
67	Syed Meera	42/F	7/07	34	5	3	-	-	-	√	N	N	-	+	N	N	N	-	-
68	Karuppaiah	68/M	7/07	32.7	6	5	√	Yes	-	√	N	N	-	+	↑	N	CHRDU	-	-
69	Chinnammal	47/F	8/07	27.1	6	4	-	-	-	√	N	N	-	+	↑	N	N	-	-
70	Prabhavathi	45/M	8/07	283	2	3	-	-	-	√	N	N	-	+	↑	N	N	-	-
71	Pandi	27/M	8/07	232	3	2		-	-	√	N	N	-	+	↑	N	N	-	-

MASTER CHART

Sl. No	Name	Procedure			(open) Incision		(lap) Approach		Technique used		Operative time (mins)	Surgeon's Exp	Methylene blue injection	Difficult lap cholecys tectomy	Complications							Further intervention
		Open	Lap	Lap--> open	Kocher's	Midline	No.of 10mm ports	No.of 5mm ports	cystic duct first	Fundus first					Bile duct injuries		Wound dehiscence	Wound infection	Respiratory infection	Incisional hernia	Port site hernia	
															Minor (leaks)	Major (stricture)						
1	2	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41
1.	Devanai	√	-	-	√	-	-	-	√	-	40	>20	No	-	-	-	-	-	-	-	-	Nil
2.	Anjammal	√	-	-	√	-	-	-	√	-	49	10-20	No	-	-	-	-	-	-	-	-	Nil
3.	Maheshwari	√	-	-	√	-	-	-	√	-	110	<10	No	-	-		-	√	-	-	-	Y
4.	Pramila	√	-	-	√	-	-	-	-	√	42	>20	No	-	-	-	-	-	-	-	-	Nil
5.	Guruvammal	√	-	-	√	-	-	-	√	-	47	10-20	No	-	-	-	-	-	-	-	-	Nil
6.	Soundarajan	√	-	-	√	-	-	-	√	-	79	<10	No	-	-	-	-	-	-	-	-	Nil
7.	Natchiammal	√	-	-	√	-	-	-	-	√	44	>20	No	-	-	-	-	-	-	-	-	Nil
8.	Vallaimmal	√	-	-	-	√	-	-	√	-	77	<10	No	-	-	-	-	-	-	-	-	Nil
9.	Paulraj	-	√	-	-	-	2	2	√	-	51	>20	Yes	-	-	-	-	-	-	-	-	Nil
10.	Fathima	-	√	-	-	-	2	2	√	-	67	>20	Yes	-	-	-	-	-	-	-	-	Nil
11	Udaiyar	-	√	-	-	-	2	2	√	-	69	>20	Yes	-	-	-	-	-	-	-	-	Nil
12	Kannaiah	√	-	-	√	-	-	-	√	-	71	10-20	No	-	-	-	-	-	-	-	-	Nil
13	Sherine	√	-	-	√	-	-	-	√	-	78	<10	No	-	-	-	-	-	-	-	-	Nil
14	Ramu	√	-	-	√	-	-	-	√	-	72	<10	No	-	-	-	√	-	-	-	-	Nil
15	Rani	√	-	-	√	-	-	-	√	√	71	<10	No	-	-	-	-	-	-	-	-	Nil
16	Saminathan	√	-	-	√	-	-	-	√	-	51	>20	No	-	-	-	-	-	-	-	-	Nil
17	Mamoon	√	-	-	√	-	-	-	-	√	52	10-20	No	-	-	-	-	-	-	-	-	Nil
18	Selvi	-	√	-	-	-	2	2	√	-	64	>20	Yes	-	-	-	-	-	-	-	-	Nil
19	Arun kumar	-	√	-	-	-	2	2	√	-	60	>20	Yes	-	-	-	-	-	-	-	-	Nil
20	Pichaiammal	√	-	-	√	-	-	-	√	-	54	10-20	No	-	-	-	-	-	-	-	-	Nil
21	Brunda	√	-	-	√	-	-	-	√	-	62	<10	No	-	-	-	-	-	-	-	-	Nil
22	Gandhi	√	-	-	√	-	-	-	-	√	53	>20	No	-	-	-	-	-	-	-	-	Nil
23	Latha	√	-	-	√	-	-	-	√	-	65	<10	No	-	-	-	-	-	-	-	-	Nil
24	Sameera	-	√	-	-	-	2	2	√	-	63	10-20	Yes	-	-	-	-	-	-	-	-	Nil
25	Rajagopal	-	√	-	-	-	2	2	√	-	59	>20	Yes	-	-	-	-	-	-	-	-	Nil
26	Jamruth Nisha	-	√	-	-	-	2	2	√	-	102	10-20	Yes	Yes	-	-	-	-	-	-	-	Nil
27	Sundrammal	√	-	-	√	-	-	-	√	-	61	<10	No	-	-	-	-	-	-	√	-	Nil
28	Indira	-	√	-	-	-	2	2	√	-	67	>20	Yes	-	-	-	-	-	-	-	-	Nil
29	Gnanasekaran	-	√	-	-	-	2	2	√	-	61	10-20	Yes	-	-	-	-	-	-	-	-	Nil
30	Palanichamy	√	-	-	√	-	-	-	√	-	62	<10	No	-	-	-	-	-	-	-	-	Nil
31	Muthusamy	√	-	-	√	-	-	-	-	√	90	10-20	No	-	-	-	-	-	-	-	-	Nil
32	Ameena beevi	-	√	-	-	-	2	2	√	-	55	>20	Yes	-	-	-	-	-	-	-	-	Nil
33	Subramaniam	√	-	-	√	-	-	-	-	√	41	10-20	No	-	-	-	-	-	-	-	-	Nil
34	Annalakshmi	-	√	-	-	-	2	2	√	-	55	>20	Yes	-	-	-	-	-	-	-	-	Nil
35	Thottichi	√	-	-	√	-	-	-	√	-	61	<10	No	-	-	-	-	-	-	-	-	Nil

Sl. No	Name	Procedure			(open) Incision		(lap) Approach		Technique used		Operative time (mins)	Surgeon's Exp	Methylene blue injection	Difficult lap cholecys tectomy	Complications							Further intervention
															Bile duct injuries		Wound dehiscence	Wound infection	Respiratory infection	Incisional hernia	Port site hernia	
		Open	Lap	Lap--> open	Kocher's	Midline	No.of 10mm ports	No.of 5mm ports	cystic duct first	Fundus first					Minor (leaks)	Major (stricture)						
1	2	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41
36	Sheela	√	-	-	-	√	-	-	-	√	43	10-20	No	-	-	-	-	-	-	-	-	Nil
37	Chitra devi	√	-	-	√	-	-	-	√	-	45	>20	No	-	-	-	-	-	-	-	-	Nil
38	Muniyammal	√	-	-	√	-	-	-	-	√	60	<10	No	-	-	-	-	-	-	-	-	Nil
39	Chellaih	-	√	-	-	-	2	2	√	-	52	10-20	Yes	-	-	-	-	-	-	-	-	Nil
40	Sugumar	-	√	-	-	-	2	2	√	-	53	>20	Yes	-	-	-	-	-	-	-	-	Nil
41	Anwar ali	-	√	-	-	-	2	2	√	-	50	10-20	Yes	-	-	-	-	-	-	-	-	Nil
42	Premkumar	-	-	√	√	-	2	3	√	-	120	<10	No	Yes	-	-	-	√	-	-	-	Nil
43	Palaniammal	-	√	-	-	-	2	2	√	-	50	>20	Yes	-	-	-	-	-	-	-	-	Nil
44	Lakshmi	-	√	-	-	-	2	2	√	-	79	10-20	Yes	-	-	-	-	-	-	-	-	Nil
45	Rajammal	-	√	-	-	-	2	2	√	-	52	>20	Yes	-	-	-	-	-	-	-	-	Nil
46	Backiam	√	-	-	√	-	-	-	-	√	45	10-20	No	-	-	-	-	-	-	-	-	Nil
47	Kaliammal	√	-	-	√	-	-	-	√	-	50	>20	No	-	-	-	-	-	-	-	-	Nil
48	Kathirmani	-		-	-	-	2	2	√	-	51	>20	Yes	-	-	-	-	-	-	-	-	Nil
49	Paulpandi	√	-	-	√	-	-	-	-	√	62	<10	No	-	-	-	-	-	√	-	-	Nil
50	Shanmuganathan	√	-	-	√	-	-	-	-	√	47	10-20	No	-	-	-	-	-	-	-	-	Nil
51	Meenakshi	-	√	-	-	-	2	2	√	-	92	>20	Yes	Yes	-	-	-	-	-	-	-	Nil
52	Dharmapoopathy	-	√	-	-	-	2	2	√	-	46	10-20	Yes	-	-	-	-	-	-	-	-	Nil
53	Sumathi	-	√	-	-	-	2	2	√	-	45	>20	Yes	-	-	-	-	-	-	-	-	Nil
54	Angammal	√	-	-	√	-	-	-	√	-	55	<10	Yes	-	-	-	-	-	-	-	-	Nil
55	Alagumani	√	-	-	√	-	-	-	√	-	50	10-20	No	-	-	-	-	-	-	-	-	Nil
56	Jothi	-	√	-	-	-	2	2	√	-	85	>20	Yes	Yes	-	-	-	-	-	-	-	Nil
57	Pandian	-	√	-	-	-	2	2	√	-	70	<10	Yes	-	-	-	-	-	-	-	-	Nil
58	Pandiselvi	-	√	-	-	-	2	2	√	-	43	10-20	Yes	-	-	-	-	-	-	-	-	Nil
59	Valli	√	-	-	√	-	-	-	√	-	55	<10	No	-	-	-	-	-	-	-	-	Nil
60	Vellaisamy	√	-	-	√	-	-	-	√	-	56	<10	No	-	-	-	-	-	-	-	-	Nil
61	Vijaya	-	√	-	-	-	2	2	-	√	50	>20	Yes	-	-	-	-	-	-	-	-	Nil
62	Jothi	√	-	-	√	-	-	-	√	-	45	10-20	No	-	-	-	-	-	-	-	-	Nil
63	Muthu	-	√	-	-	-	2	2	√	-	82	10-20	Yes	Yes	-	-	-	-	-	-	-	Nil
64	Sulaiman	√	-	-	√	-	-	-	√	-	53	<10	No	-	-	-	-	-	-	-	-	Nil
65	Sujatha	-	√	-	-	-	2	2	√	-	42	>20	Yes	-	-	-	-	-	-	-	-	Nil
66	Velan	-	√	-	-	-	2	2	√	-	44	10-20	Yes	-	-	-	-	-	-	-	-	Nil
67	Syed Meera	-	√	-	-	-	2	2	√	-	44	>20	Yes	-	-	-	-	-	-	-	-	Nil
68	Karuppaiah	-	√	-	-	-	2	2	√	-	78	10-20	Yes	Yes	-	-	-	√	-	-	-	Nil
69	Chinnammal	-	√	-	-	-	2	2	√	-	42	<10	Yes	-	-	-	-	-	-	-	-	Nil
70	Prabhavathi	-	√	-	-	-	2	2	√	-	41	>20	Yes	-	-	-	-	-	-	-	-	Nil
71	Pandi	-	√	-	-	-	2	2	√	-	41	>20	Yes	-	-	-	-	-	-	-	-	Nil