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STUDY ON THE CONVERSION OF LAPAROSCOPIC CHOLECYSTECTOMY OWING TO PER OPERATIVE COMPLICATIONS

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STUDY ON THE CONVERSION OF LAPAROSCOPIC CHOLECYSTECTOMY OWING TO PER OPERATIVE COMPLICATIONS

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INTRODUCTION

In the modern medical era, laparoscopic approach to surgical conditions have reached to a height that it is performed even for malignant conditions. The Minimal access Surgery which has grown up from minimally invasive surgery has given us the faith that nearly all surgeries can be done by laparoscopy.

HISTORY OF LAPAROSCOPIC CHOLECYSTECTOMY:

The first laparoscopic cholecystectomy was done by **Prof. Dr. Med Erich Muhe of Germany** in the year 1985 . He has been awarded the German surgical society anniversary award in the year 1992.

The laparoscopic cholecystectomy is performed by two different techniques,

(A) The DA VINCI system

(B) The BONATI system

About ten lakh cholecystectomies are performed ever year , of which 96% are done by laparoscopic method . laparascopic cholecystectomy is the most common laparoscopic procedure that is done today in the modern medical era.

By number of studies and research works , it is stated that laparoscopic cholecystectomy is superior to conventional open method because of its advantages like smaller incisions , early recovery, less post operative pain and hospital stay, better cosmesis. However laparoscopic cholecystectomy also has got its own disadvantages and complications .

In 1992, a NIH consensus conference held in Bethesda approved laparoscopic cholecystectomy as the treatment of choice for symptomatic cholelithiasis.

Conversion to open technique is a major morbidity of laparoscopy as it looses its supremacy over open technique once the conversion takes place.With growing experience of laparoscopic cholecystectomy and completion of the learning curve, the indications for laparoscopic cholecystectomy have been extended approaching that of opaen cholecystectomy.

Complications of laparoscopic cholecystectomy have been minimized to as low as 2-6%.3 However, a substantial proportion of patients had to be converted to open operation because of technical difficulties or intraoperative complication. Conversion rates of 2.6% to 14% had been described in different studies. The factor to be considered with conversion is that it should never be considered a complication, but rather a correct judgement by the surgeon.

AIM OF THE STUDY

The aim of the present study is

1. To study the **incidence of conversion** of laparoscopic Cholecystectomy

2. To analyse the **reasons for the conversion** of laparoscopic cholecystectomy owing to per operative complications like ,

   (A) Arterial injury

   (B) Hepato biliary tract injury

   (C) Dense adhesions

   (D) Aberrant anatomy

   (E) Technical issues

REVIEW OF LITERATURE

(1) Raad S Al –saafar et al of Al –najaf medical university after analyzing 300 cases from 2007 to 2009 stated that the conversion rate in laparoscopic cholecystectomy was 1.66% , of which dense adhesions being the most common cause for conversion.

(2) Muhammed Shamim et al of Fatima and Baqai hospital after observing 1238 patients concluded that the conversion rate in laparoscopic cholecystectomy was 6%(81 patients) of which Calots triangle

adhesions-44

Arterial injury-11

Wide cystic duct -7

CBD injury-5

Equipment failure-9

Bowel injury-5

(3) Changiz Gholipur et al Tabriz medical college , Iran in 2009 concluded that the conversion rate in laparoscopic cholecystectomy was 9% and it can be predicted pre operatively by ANN(Artificial Neural Network)

(4) Iftirkhar A. Khan et al after analysis of 44 patients who underwent laparoscopic cholecystectomy for acute cholecystitis observed that the conversion rate in laparoscopic cholecystectomy was 23 %.

(5) Ajay Anand et al of India observed 176 patients from 2002 to 2003 and stated that the conversion rate in laparoscopic cholecystectomy was 11.93%. (21 patients)

Adhesions	-	8 (3.54%)
Bleeding	-	5 (2.84%)
Unclear anatomy	-	3 (1.70%)
CBD injury	-	2 (1.14%)
Equipment failure	-	3 (1.70%)

(6) **Volkan Genc et al** of Ankara medical university, Turkey after analyzing 5164 patients from 1999 to 2010 stated that the conversion rate in laparoscopic cholecystectomy was 3.16% and most of it was due adhesions of Calots triangle

(7) **Pavlidis et al** in 2007 stated after studying 1263 patients that the conversion rate in laparoscopic cholecystectomy was 6.3%.

(8) **S K Biswas et al** of Bangladesh after analyzing 760 patients from 2006 to 2011 observed that the conversion rate in laparoscopic cholecystectomy was 2.5% (19 patients)

Calots Adhesions	-	6 (2.5 %)
Bleeding	-	2 (0.26 %)
Acute cholecystitis	-	5 (0.66 %)
CBD injury	-	3(0.40 %)
Equipment failure	-	3 (0.40 %)

(9) **Jeremy M Lipman M D** in surgery vol 142, issue 4, oct 2002 ; 556-565 quoted that the conversion rate in laparoscopic cholecystectomy was 34.8%

(10) A. Alponet et al ; world journal surgery 1997 ; july-august; 21(6) ; 629 - 633 that the conversion rate in laparoscopic cholecystectomy was 4%

(11) Nadim Khan et al PGMI, Pakistan after observing 340 patients from 2006 to 2009 analyzed that the conversion rate in laparoscopic cholecystectomy was 6.4 % (22 patients)

Calots Adhesions – 8 (2.35 %)

Bleeding - 6 (1.59 %)

Bowel injury - 1 (0.29 %)

Hepato-biliary injury - 4 (1.16 %)

Equipment failure - 3 (0.87 %)

(12) Michael Rosen M P et al ; American journal of surgerysep 2002 ; issue 3; vol 184 ; 254-258 quoted that the conversion rate in laparoscopic cholecystectomy was 14%

(13) Singh Kuldhip et al ; Indian journal of surgery 2006; 68 ; 205 – 208 stated quoted that the conversion rate in laparoscopic cholecystectomy was 12.2 % and it is commonly due to adhesions .

(14) Malik Arshad et al in journal of minimal access surgery 2007; vol 3 ; issue 2 ; 52- 56 quoted quoted that the conversion rate in laparoscopic cholecystectomy was 19.4 %

(15) Rooh-al-Muqim et al at Khyber hospital observed 351 patients from 2005 – 2007 and concluded that the conversion rate in laparoscopic cholecystectomy was 3.13 % (11 patients)

Adhesions – 3 (0.85%)

Altered anatomy – 3 (0.85 %)

Bleeding – 5 (1. 43 %)

(16) H.J.J Van der steeg et al , Netherland analysed 972 cases from 2000-2006 concluded that the conversion rate in laparoscopic cholecystectomy was 12% (121 patients)

(17) Saeed Hadi Al –Bahlooli of Yemen observed 650 patients and stated that the conversion rate in laparoscopic cholecystectomy was 8.3 % (59 patients), adhesions being the most common cause

(18) In NEJM 1991;324;1074-1078 , 20 surgical groups analysed 1518 laparoscopic cholecystectomies and concluded that the conversion rate in laparoscopic cholecystectomy was 4.7 % (72 patients) of which

Adhesions – 36 (2.3 %)

Aberrant anatomy – 6 (0.4%)

Bleeding – (5 (0.3 %)

CBD injury – 4(0.3 %)

Bowel injury – 4 (0.3 %)

(19) Gabriel R Kumar of India in 2005 stated that the conversion rate in laparoscopic cholecystectomy was 26 %

(20) Chi – Leung Liu et al in 1996 after observing 500 patients concluded that the conversion rate in laparoscopic cholecystectomy was 9 %.

(21) Rosen et al in their study of 1347 patients in 2002 stated that the conversion rate in laparoscopic cholecystectomy was 5.3 %

(22) Mossad Morshad et al 1999 of Mansoura faculty of medicine observed that the conversion rate in laparoscopic cholecystectomy was 6 %

(23) Muhammed Rafique Memon of Pakistan, in 2010 stated that the conversion rate in laparoscopic cholecystectomy was 0.65 % of which adhesions noted in 0.25 %

(24) Malla BR , Katmandu university in 2009 stated that the conversion rate in laparoscopic cholecystectomy was 3.92%

(25) Vikas Gupta et al SKIMS-India stated that the conversion rate in laparoscopic cholecystectomy was 7.5 %

(26) Waseem et al in 2008 observed that the conversion rate in laparoscopic cholecystectomy was 4% after study of 216 patients .

(27) Ishizaki et al of Japan 2006 stated that the conversion rate in laparoscopic cholecystectomy was 5.3 % after a study of 1179 patients.

ANATOMY PERTAINING TO CHOLECYSTECTOMY

Gallbladder is a pear shaped organ of size 7 to 10 cm , lies in the gallbladder fossa of visceral surface of right lobe of liver and covered by peritoneum. Its capacity is about 50 ml . it is attached to the liver by means of a fibrous capsule of the liver It has three parts ,

- Fundus- the wide blunt end that projects from inferior surface of the liver at the tip of 9^{th} rib in the mid clavicular line.
- Body- main portion that contacts the liver , transverse colon,and the duodenum
- Neck- narrow , tapering end and is directed towards the porta hepatis through which bile drains into cystic duct which is 3 to 4 cm long which in turn join with common hepatic duct to form the common bile duct.

The mucosa of the neck has the spiral valve which keeps the cystic duct open so that the bile is converted to the gall bladder when the end of the common bile duct is closed by bile duct sphincter.

The blood supply of the gall bladder and the cystic duct is from the cystic artery which arises from the right hepatic artery in the triangular area between common hepatic duct , inferior surface of the liver and the cystic duct known as CYSTOHEPATIC TRIANGLE OF CALOT'S .

The cystic vein drains the neck of the gall bladder and the cystic duct which in turn joins the liver directly or through tne portal vein .the venous drainage from the fundus and the body drains directly to the hepatic sinusoids .

Lymphatic drainage from the gall bladder is to the cystic lymph node and to the hepatic nodes . nerve supply to the gall bladder is from the celiac plexus , the vagius , the right phrenic nerve.

Parasympathetic stimulation causes the gall bladder to contractand relaxes the sphincter at the ampulla of Vater.

Hartmann's pouch is an abnormal sacculation at the neck of the gall bladder and the cystic duct which appears in the diseased state and is the potential site for gall stone impaction.

ANATOMICAL ABERRATIONS :

Only 30 % of the individual show classical anatomy. There are various anomalies of GB, cystic duct and cystic artery which should be kept in mind to avoid injury to those structures.. Aberrant anatomy is a well-recognized risk factor for injury to those vital structures

Anomalies can be in **Gall Bladder, Cystic Duct, Hepatic Ducts, Blood Vessels**

- Cystic artery, a branch of Right hepatic artery is usually given off behind the common hepatic duct supplies the gall bladder. Anatomy of calots triangle is very important during Laparoscopic cholecystectomy. It is important to clearly identify the structures forming the sides of Calot's triangle. The boundaries of Calot's triangle include the cystic duct, cystic artery, and the common hepatic duct, which is different from hepatocystic triangle proper, which is the anterior aspect of the area bounded by the gallbladder wall and cystic duct, the liver edge, and the common hepatic duct; the cystic artery lies within this space.

- The cystic duct may join the common hepatic duct at an acute angle, travel parallel to the common duct for several centimeters prior to insertion or insert into the right hepatic duct, or sometimes be congenitally absent. Sometimes cystic duct might join the common duct very distally (low union) and in some cases more proximally (high union)

- Hepatic ducts may be aberrant and assume dangerous positions like an accessory duct joining thecommon duct outside the liver.

- The cystic artery usually arises from the right hepatic artery .

- The right hepatic artery may occasionally will loop up onto the surface of the gallbladder, and a very short cystic artery will arise and it may arise from another source other than hepatic artery proper, most commonly from the Superior Mesenteric Artery

- The left hepatic artery may aberrantly arise from the left gastric artery.

- In most individuals the right hepatic artery crosses runs posterior to the common hepatic duct and in few persons it may aberrantly

cross in front of the common hepatic duct and in some it may not cross at all if it is arising from the superior mesenteric artery.

- There can often be a posterior cystic artery, which can easily be injured if not recognized .

- The aberrant right hepatic duct anomaly is the most common problem. The most dangerous variant is when the cystic duct joins a low-lying aberrant right sectional duct

LAPAROSCOPIC ANATOMY

The advent of laparoscopic cholecystectomy has opened a new way in the biliary anatomy particularly in the area of calot's triangle.laparoscopic anatomy is different from the anatomy texts we read .the method of retraction that is done in the laparoscopic cholecystectomy tend sto distort the anatomy of calot's triangle.and the dissection of posterior aspect of the calot's which is not done in the open method usually, as the gall bladder is not flipped over in the open method.

The Rouviere's sulcus, is a fissure between the caudate process and the right lobe of liver and is clearly seen only in the laparoscopic cholecystectomy while performing the posterior dissection of calot's triangle.

The Rouviere's sulcus's is an area which corresponds to the porta hepatis and marks the site where the right duct enters the liver and thus it is advised that all the dissections should be done anterior to this landmark.

The calot's anatomy is not always exactly the same as text books in the patients, as there will be adhesions / fibrosis due to inflammatory conditions.and most of the times the boundaries are not seen clearly because of this reason.

In order to prevent injury to the vital structures , clear definition of anatomy per operatively and pre operative imaging studies may help a lot.

CHOLELITHIASIS [GALL STONE DISEASE]

Symptomatic cholelithiasis is the most common indication for cholecystectomy . about 86% of patients are asymptomatic who needs conservative line of management.

Gall stones are classified into

- Cholesterol stones
- Pigment stones which may be

  Brown pigment stones or Black pigment stones

PATHOPHYSIOLOGY OF CHOLELITHIASIS

A. Most important is the supersaturated bile

B. Gall bladder malfunction

C. Cholesterol nucleating factors

D. Enterohepatic circulation of bile acid and its absorption

Bile facilitates absorption of lipids and fat soluble Vitamins from the intestines and is the main route of excretion of bilirubin and cholesterol. Bile salt solubilise lipids and promotes its absorption. Phospholipids are synthesized in the liver in conjugation with bile salt. Cholesterol is non-polar, insoluble in water and in bile.

Gall stone represents a malfunction of the gall bladder to maintain certain biliary solutes, cholesterol and calcium salts in a ionised state. One of the most important biliary precipitate in gallstone disorder is “bile sludge”, which is a combination of cholesterol crystals, calcium bilirubinate granules and mucin gel.. Biliary sludge is also known to occur in patients who are in prolonged fasting states or in those where there is long term use of parenteral nutrition.

CHOLESTEROL GALLSTONES :

The formation of cholesterol gallstones is due to multiple factors which progress through three stages.

- Cholesterol supersaturation
- Stone growth
- Crystal nucleation

The motor function of the gall bladder and its mucosa plays key role in gallstone formation. Formation of both micelles, a bile salt – phospholipid – cholesterol complex and cholesterol – phospholipid vesicles is the key factor for maintaining cholesterol in solution . The solubility cholesterol depends on the relative concentrations of cholesterol, bile salts and phospholipid.

Cholesterol supersaturation can occur even in normal persons Without formation of gallstones. Cholesterol supersaturation results in metastable state in which cholesterol precipitation may take place and additional factors in bile must be present to enhance or inhibit nucleation of cholesterol leading to gallstone formation.

Nucleation is the process in which cholesterol monohydrate crystals form and conglomerate. As bile gets concentrated in the gall bladder, a gross transfer of phospholipids and chlolesterol from vesicle to micelles occurs. The phospholipids are transferred more effectively than the cholesterol, leading to cholesterol enrichment of the left out vesicles which aggregate to form multi lamellar liquid vesicles which then precipitates cholesterol monohydrate crystals. The nucleating factors like mucin ,glycoproteins , transferring and , immunoglobulins accelerate precipitation of cholesterols in the bile.

For gallstones to cause symptoms, they must be large enough to produce mechanical injury to gall bladder or obstruction of the hepato biliary tree.

Stones may enlarge progressively in two ways.

- By deposition of insoluble precipitate at the bile – stone interface
- Fusion of individual crystals or stones to form a larger conglomerate.

In addition to above said mechanisms , defects in gall bladder motor function will increase the storage time of bile in the gall bladder , thereby facilitating stone formation. This is the reason why gallstones forms in clinical states with gallbladder stasis, as with prolonged fasting, long term parenteral nutrition, after vagotomy and in patients with somatostatin – producing tumors or in patients receiving somatostatin therapy.

PIGMENT GALLSTONES

The precipitation of calcium salts with anions, bilirubin, carbonate, phosphate or palmitate forms an insoluble calcium salts and it serves as a nidus in which pigment stone forms. Furthermore, calcium bilirubinate, and calcium palmitate also forms major components of pigment gallstones.

Pigment stones may be brown or black. Black pigment stones are tarry and are associated with hemolysis where bilirubin load and concentration of unconjucated bilirubin increases and also in cirrhosis liver.

Brown stones are earthy in consistency and found usually in the bile ducts.. These stones contain more cholesterol and calcium palmitate and occurs in patients with disorders of gall bladder motility and associated bacterial infection.

COMPLICATIONS OF GALLSTONES

a) In the Gall Bladder

1. Acute Cholecystitis
2. Chronic Cholecystitis
3. Gangrene of the gall bladder
4. Perforation / fistula
5. Empyema gall bladder
6. Mucocele, especially in diabetic patients
7. Carcinoma,rare, but should be considered in mind

b) In the Bile Duct

1. Obstructive Jaundice which may be progressive
2. Cholangitis
3. Acute Pancreatitis

c) In the bowel

1. Acute intestinal Obstruction , condition known as gall stone ileus, mostly in the region of ileo-caecal valve.
2. Fistulas

Silent stones are those which do not produce symptoms, that are found incidentally during examination for other pathology

PROPLYLACTIC CHOLECYSTECTOMY is the surgery done in asymptomatic patients and is indicated in the following high risk groups.

- Diabetic patients, for fear of mucocele
- Immunosuppressed patients
- Renal transplant candidates
- Stones > 2 cm
- Multiple small stones
- Increased risk of gall bladder carcinoma.
- Porcelain gall bladder
- Cholesterosis gall bladder.

INCIDENTAL CHOLECYSTECTOMY is done in patients undergoing abdominal surgery for some other pathology with indicental finding of gall stones, only if the general condition of the patient permits.

INDICATIONS FOR LAPAROSCOPIC CHOLECYSTECTOMY:

- Symptomatic cholelithiasis
- Incapacitating Biliary colic
- Acute cholecystitis
- Recurrent pancreatitis due to gallstone
- Sickle cell disease
- Patients on long term Total parenteral nutrition
- Chronic immunosuppression
- Incidental cholecystectomy in patients undergoing surgery for other indications
- Acalculous cholecystitis (biliary dyskinesia)
- Gallbladder polyps >1 cm in diameter
- Porcelain gallbladder

ABSOLUTE CONTRA INDICATIONS FOR LAPAROSCOPIC CHOLECYSTECTOMY

- Unable to tolerate general anesthesia
- Bleeding diathesis
- Gallbladder carcinoma

RELATIVE CONTRA INDICATIONS FOR LAPAROSCOPIC CHOLECYSTECTOMY

- Cholangitis
- Peritonitis
- Cirrhosis
- Chronic obstructive pulmonary disease
- Cholecystoenteric fistula
- Morbid obesity
- Pregnancy

LAPAROSCOPIC INSTRUMENTS

OPERATING ROOM SETUP

The operating room setup includes equipment which properly positions the patient. Operative laparoscopic and video equipment and well coordinated assistant, Anasthesiologist, and nursing team are all required.

There are two techniques of performing laparoscopic cholecystectomy

In the "American" technique, the surgeon stands to the left of the patient, the first assistant stands to the patient's right and camera operator stands to the left of the surgeon.

In the "French" technique, the patient's legs are abducted and the surgeon stands between the legs.

The camera operator must always maintain the proper orientation of the camera and keep the operating instruments in the center of the video image.

OPTICAL INSTRUMENTS

- Laparoscope 5mm, 10mm – 0 and 30 degree
- Computed chip video camera
- Light source
- Video monitor

ABDOMEN ACCESS EQUIPMENTS

- Veress needle or Hasson cannula
- Gas cylinder (C02) with Insufflators
- Trocar and cannulas

LAPAROSCOPIC INSTRUMENTS

- Atraumatic grasping forceps
- Bipolar coagulation forceps
- Maryland Dissecting forceps
- Scissors
- Clip applicators
- Endo pouches (or) Sacs
- Sutures and needles
- Needle holder
- Suction and irrigation system

VIDEO CAMERA

The video camera is attached directly to the eye piece of the laparoscope and contains both manual focus mechanism and zoom capability.

LAPAROSCOPES

Commonly used laparoscopes are rigid instruments that employ the Hopkins rod lens system of optics. It comes in sizes ranging 26 between 3mm to 10mm in diameter and variety of viewing angles. The 0 degree or end/ forward viewing is easy to use and results in least amount of image distortion. Recently, flexible scopes have been developed.

INSUFFALATORS

Insuffalators used to create working space within the abdominal cavity by delivering C02 via an automatic high flow pressure – regulatorsystem. C02 is currently the agent of choice because of low toxicity, low risk of gas embolism, rapid reabsorption, low cost and ease of use. Ideal insuffalator should be able to deliver 8 to 10L/min with a minimum acceptable flow rate of 6L/min. It regulates flow rate, monitors intra abdominal pressure and stops delivering C02 whenever the pressure exceeds predetermined level of 12 to 15mm Hg.

PUNCTURE INSTRUMENTS

Pneumo peritoneum can be created by

1. **Veress needle** achieve pneumoperitoneum in a "Closed" fashion. It has outer sharp cutting needle and inner blunt spring loaded obturator. Once cutting needle enter peritoneal cavity blunt stylet springs forward thereby reducing injury.

2. **Hasson cannula** is used to create pneumoperitoneum in a "opened" fashion. Its use avoids inadverdent injury to the bowel and vessels which may occur occasionally.

The laparoscopic port consists of an outer hollow sheath that has a valve which prevents gas escape, port for insuffalation and a port for instrument access. The commonly used trocars are 5 mm and 10 mm in diameter.

ENDO SUTURING

They are inserted via a hollow reducing sleeve. The suture then looped around the structure and the knot slide down and closed.

THERMAL INSTRUMENTS

The modality commonly used for coagulation and the hemostasis is electrocautery – monopolar or bipolar. The entire tip of the instrument must be well visualized before cauterizing to avoid contact with nearby structures to avoid thermal injuries.

LAPAROSCOPIC CHOLECYSTECTOMY

INSTRUMENTS REQUIRED

- 10 mm direct laparoscope
- Two 5 mm and two 10 mm trocars
- Two 5 mm Maryland dissectors
- Two 5mm babcocks and graspers
- One 10 mm grasping ‘Crocodile’ forceps
- One 10 mm curved dissector
- One straight cutting scissor
- One vessel sealer with foot pedal
- One 5 mm irrigation – suction cannula
- Dissecting hook with monopolar or bipolar cautery
- 300 and 400 mm clips and clip applicator

POSITIONING

The patient is firmly strapped to the table so as to permit adjustment of the table with reverse trendelenburg position and table is tilted towards the surgeon who stands on the left side . The first assistant stands on the right side of the patient. Person handling the camera stands caudal to the surgeon.

PORTS

Umbilical 10mm - Camera port

Epigastric 10mm - Working port

Right subcostal 5 mm - Infundibulam grasper

Right ant. axillary 5 mm – for cephalad traction of gall bladder

OPERATIVE TECHNIQUE - American approach

There are 2 approaches French and American approach.

American approach is detailed here. After creating pneumoperitoneum by veress needle, first umbilical trocar introduced then all other trocars introduced one by one.

The following steps are done,

- Exposure of porta hepatis
- Adhesion release
- Decompression
- Dissection of calot's triangle
- Cystic pedicle skeletonisation
- Clipping and division of cystic pedicle
- GB dissection from its bed
- Hemostasis and drain placement
- Extraction of GB.
- Peritoneal lavage.
- Closure of the ports.

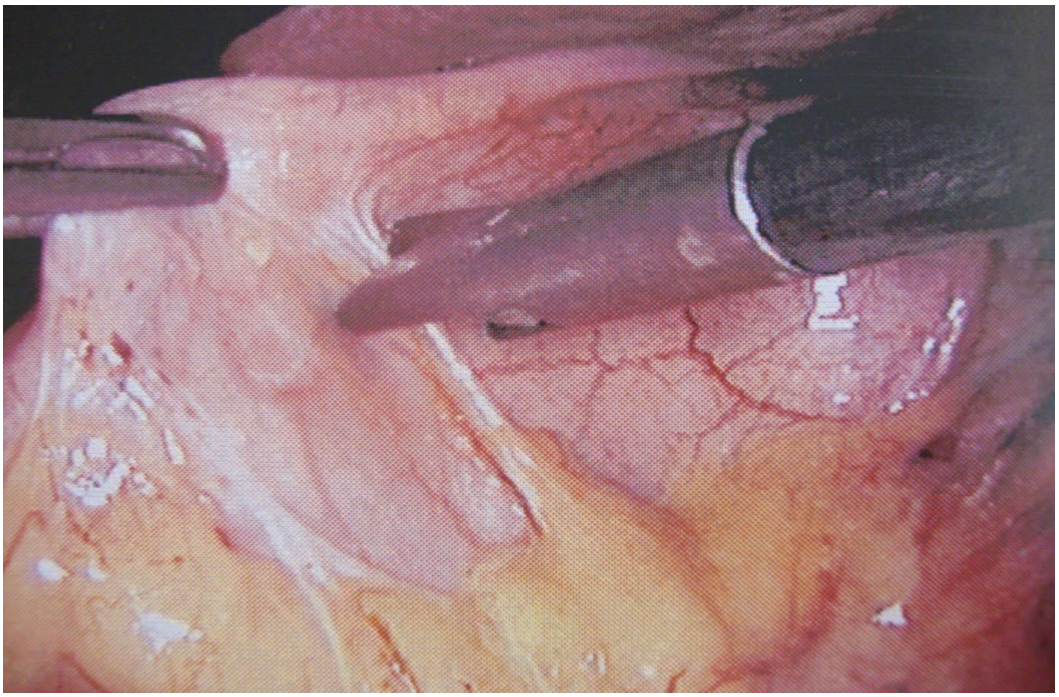
EXPOSURE OF THE PORTA HEPATIS

Exposure of the porta hepatis requires maximal elevation of the gallbladder fundus and liver edge. This elevation is usually achieved by the placement of a ratcheted, aggressive clamp on the fundus of the gallbladder from the most lateral trocar, and cephalad displacement is initiated until the infundibulum of the gallbladder, the duodenum, and the porta hepatis are well exposed . If exposure of the porta hepatis is inadequate, the patient can be placed in a more reverse Trendelenburg position, the fundic grasper can be moved farther down the gallbladder to better elevate the gallbladder, or a fifth trocar can be introduced from the patient's left side to push down on the duodenum. This last technique is rarely necessary.

STRIPPING THE PERITONEUM

Using a two-handed technique, the surgeon grasps the gallbladder infundibulum with an instrument in his or her left hand and retracts it laterally. With a fine dissector, the peritoneum is torn at the interface between the gallbladder and periportal fat. The peritoneum is teased toward the common duct until the cystic duct, cystic artery, or lymph node of Calot is identifiable. Complete stripping of the posterior cystic duct is facilitated if the surgeon pushes the infundibulum medially to strip the peritoneum off the posterior aspect of the gallbladder and cystic duct.This to-and-fro retraction of the infundibulum ensures circumferential visualization and dissection of the gallbladder infundibulum

RELEASING GALL BLADDER ADHESIONS



Releasing the adhesions around the calot's triangle is the foremost and first step in laparoscopic cholecystectomy.

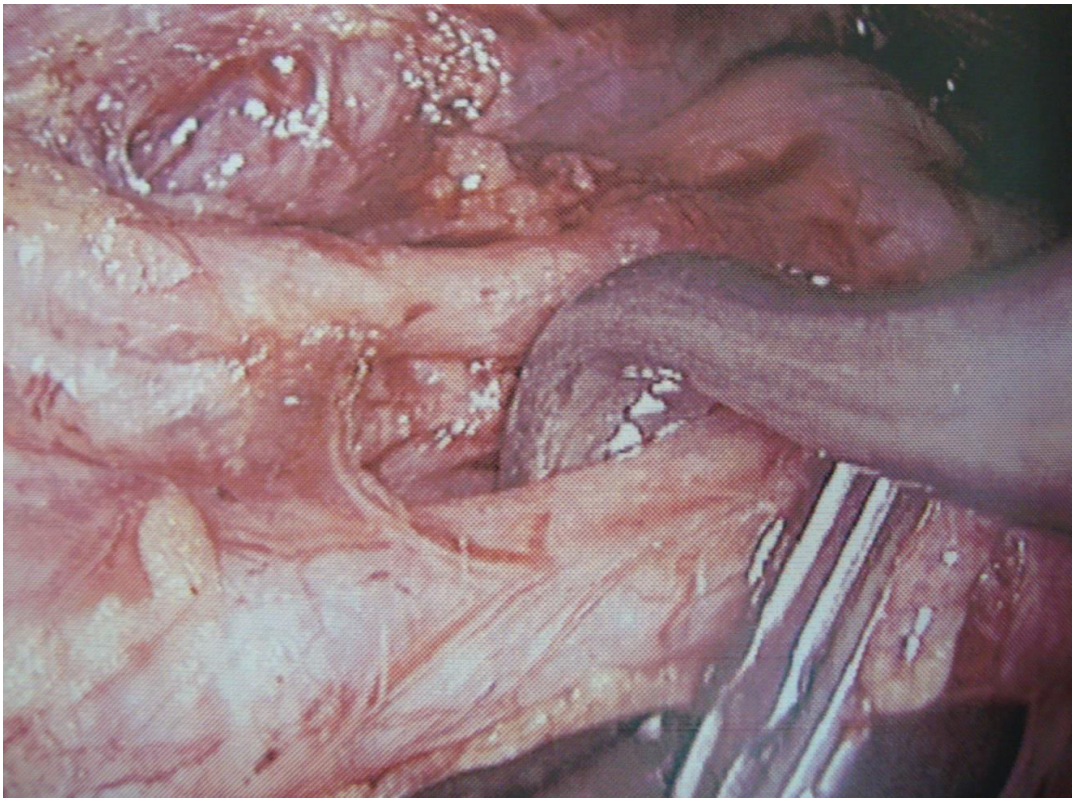
PEDUNCULATION OF THE GALLBLADDER

Stripping of the peritoneum over the gallbladder will reveal the insertion of the cystic duct into the gallbladder. Continued dissection at this interface, first with a fine dissector and then with L-hook between the cystic artery and cystic duct, provides the anatomic definition of important cystic duct anatomy. The cystic artery and lymphatics that cross the Calot triangle may be divided near the gallbladder . It is unnecessary to continue the dissection any farther down the cystic duct than is needed to place two clips on the structure. The CBD is usually seen with the angled scope, and it is almost never necessary to dissect the cystic duct down to its junction with the CBD.

CONTROL OF THE CYSTIC DUCT AND CYSTIC ARTERY

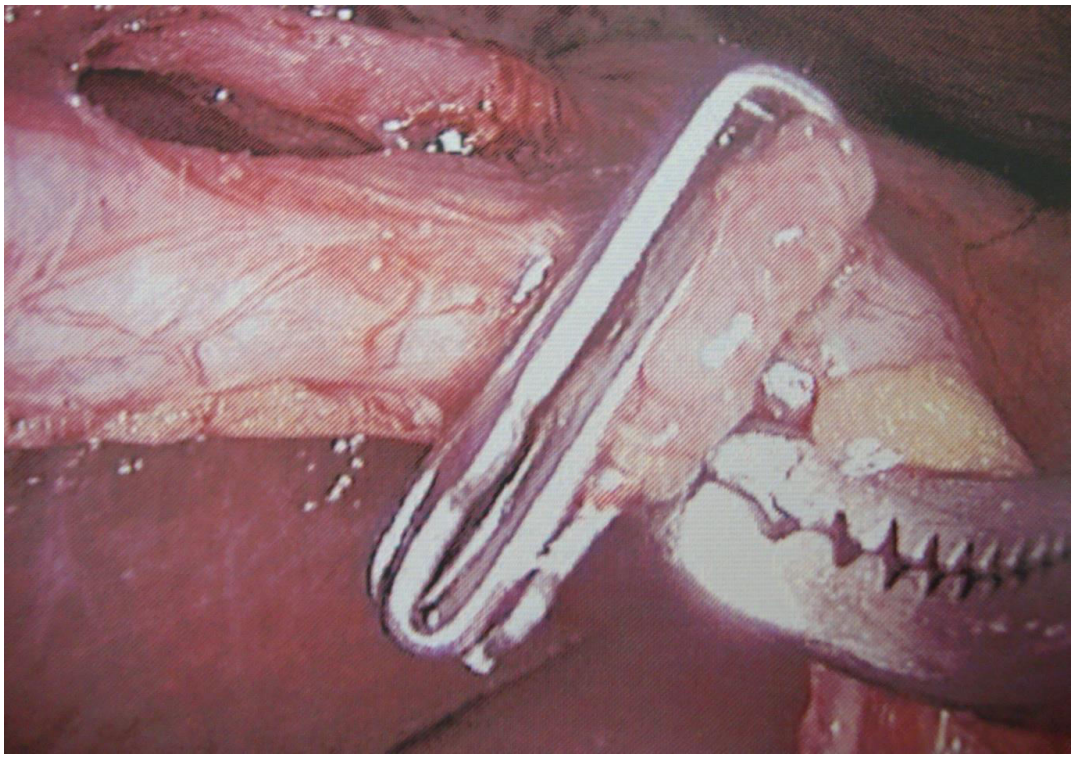
Generally, the cystic duct is narrow enough that an 300 or 400 Hemoclip can be passed around it and slid up to the infundibulum of the gallbladder, where it is closed . Two clips are placed on the cystic duct immediately below its junction with the gallbladder, and the cystic duct is divided. A long cystic duct remnant is not a concern as long as no stones are retained in this remnant. Two Hemoclips are placed on the cystic artery as it crosses onto the gallbladder, and the cystic artery is divided

CYSTIC DUCT DISSECTION



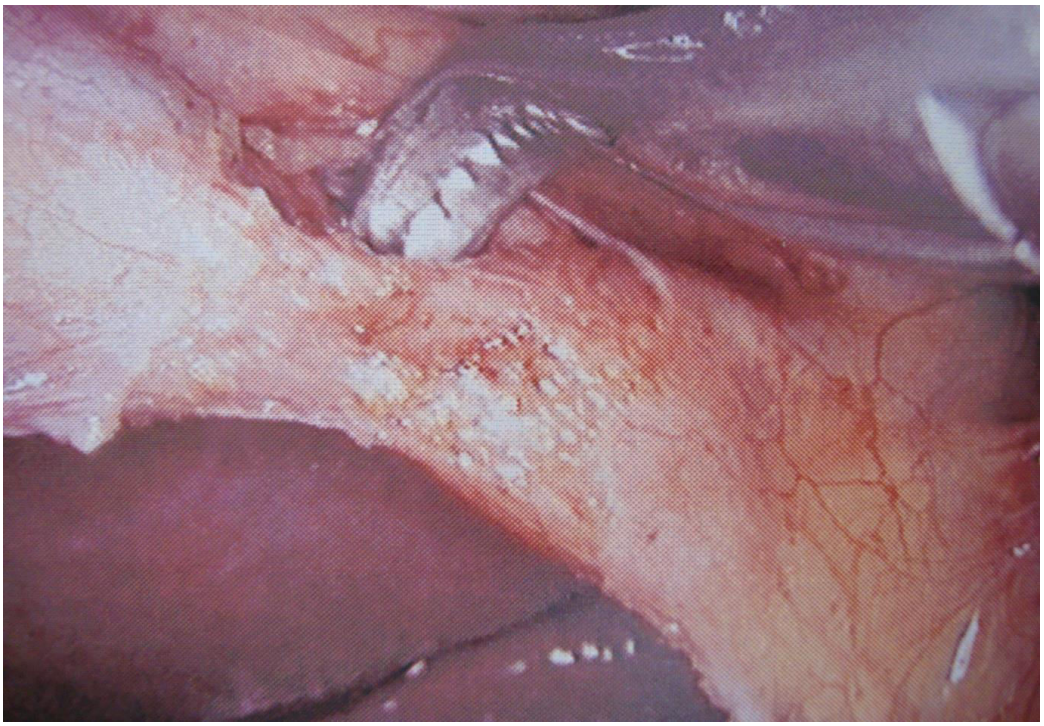
Cystic duct is dissected either by blunt or sharp dissection. Care should be taken not to injure common bile duct.

CLIPS APPLIED TO THE CYSTIC DUCT



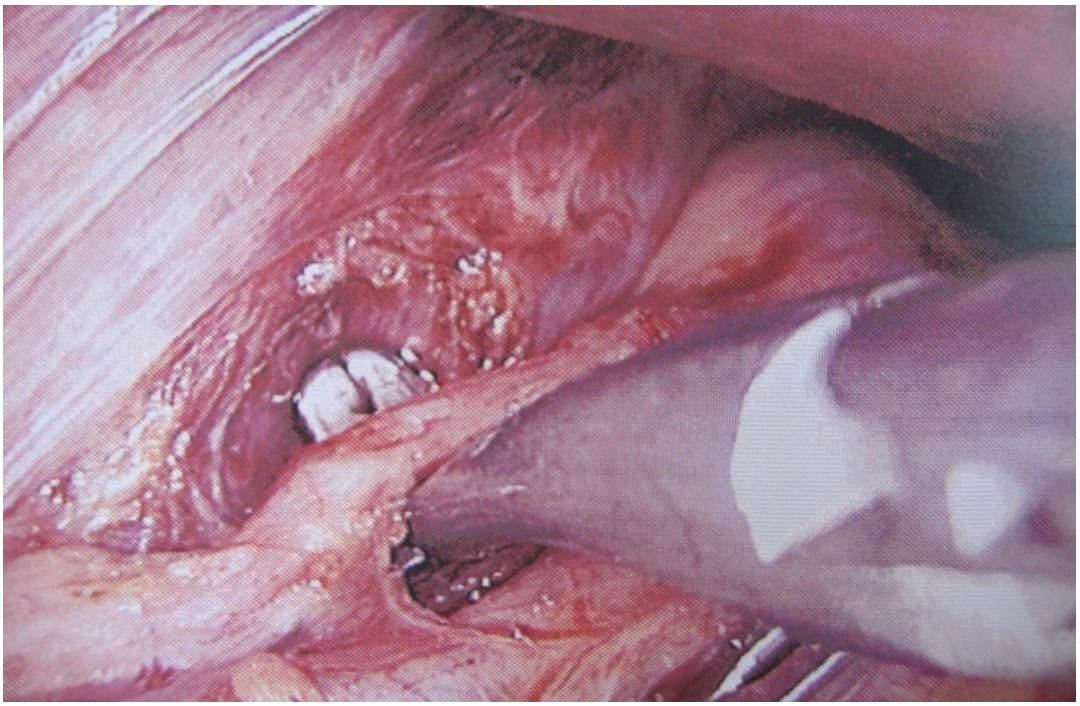
After confirming that it is cystic duct 300 (or) 400 clips are applied and cut in between the clips.

CYSTIC ARTERY IDENTIFICATION



Next step is identification of cystic artery by blunt or sharp dissection. Care should be taken not to clip Hepatic vessels.

CYSTIC ARTERY DISSECTION



After dissection 300 or 400 clips are applied to cystic artery and divided in between the clips.

CLIPPING THE CYSTIC ARTERY PRIOR TO DIVISION

After clipping the cystic artery the stump should be visualized for any bleeding.

RESECTION OF THE GALLBLADDER

If adequate pedunculation has been performed before cystic duct division, the gallbladder should already be dissected off the liver a quarter of the way to the fundus. Gallbladder resection is facilitated by strong use of the retracting (left) hand to pull the gallbladder away from the liver. As the gallbladder is pulled away from the liver, the monopolar electrode is used to coagulate the small bridging veins and areolar tissue connecting the gallbladder to the liver . If hemorrhage occurs during this dissection, it usually means that the surgeon is not in the right tissue plane, most frequently in the hepatic parenchyma. When the fundus of the gallbladder is reached, the majority of the gallbladder is flipped over onto the anterior surface of the liver, and hemostasis of the liver bed is checked. The remaining peritoneum connecting the gallbladder and liver is then divided with electrosurgery to disconnect the gallbladder from the liver.

REMOVAL OF THE GALLBLADDER

At this point, the telescope is moved to the epigastric trocar, the gallbladder is grasped with a 10-mm grasper introduced through the umbilicus, and the gallbladder and trocar are removed. If the gallbladder does not come out easily, the bile is generally removed from the gallbladder with a small suction device passed into the gallbladder below the level of the fascia.The umbilical fascia is then closed with an interrupted or figure-eight suture and the abdomen is reinflated. With the telescope through the epigastric trocar, the right upper quadrant is thoroughly irrigated, and all fluid is removed from the subphrenic space and a sub hepatic drain tube may be kept. Then the remaining trocars are all removed under direct vision, the skin is closed.

OPEN CHOLECYSTECTOMY

The location of the gallbladder on the postero-inferior surface of the liver makes exposure a key aspect in the easy performance of a cholecystectomy. The right subcostal incision provides direct access to the liver, gallbladder and also the biliary tree. Exposure to lower abdominal organs is limited in this incision . whenever access to the whole of the abdominal cavity is needed , a midline incision is a better option as it can be easily extended superiorly or inferiorly.

Retraction of the right costal margin isdone with the help of self retaining retractor. The patient is positioned in a reverse Trendelenburg position which brings the liver down from the costal margin or moist gauze packs may be placed behind the right hepatic lobe in order to bring the liver forward. A retractor is used to lift the inferior aspect of the liver up may be used taking care not to injure the liver capsule. Moist packs are used to pack away adjacent structures .A nasogastric tube is used for decompressing the stomach which enhances the exposure. Dense adhesions to the colon or duodenum must be dissected.. Dissection in all situations should be performed close to the gallbladder.

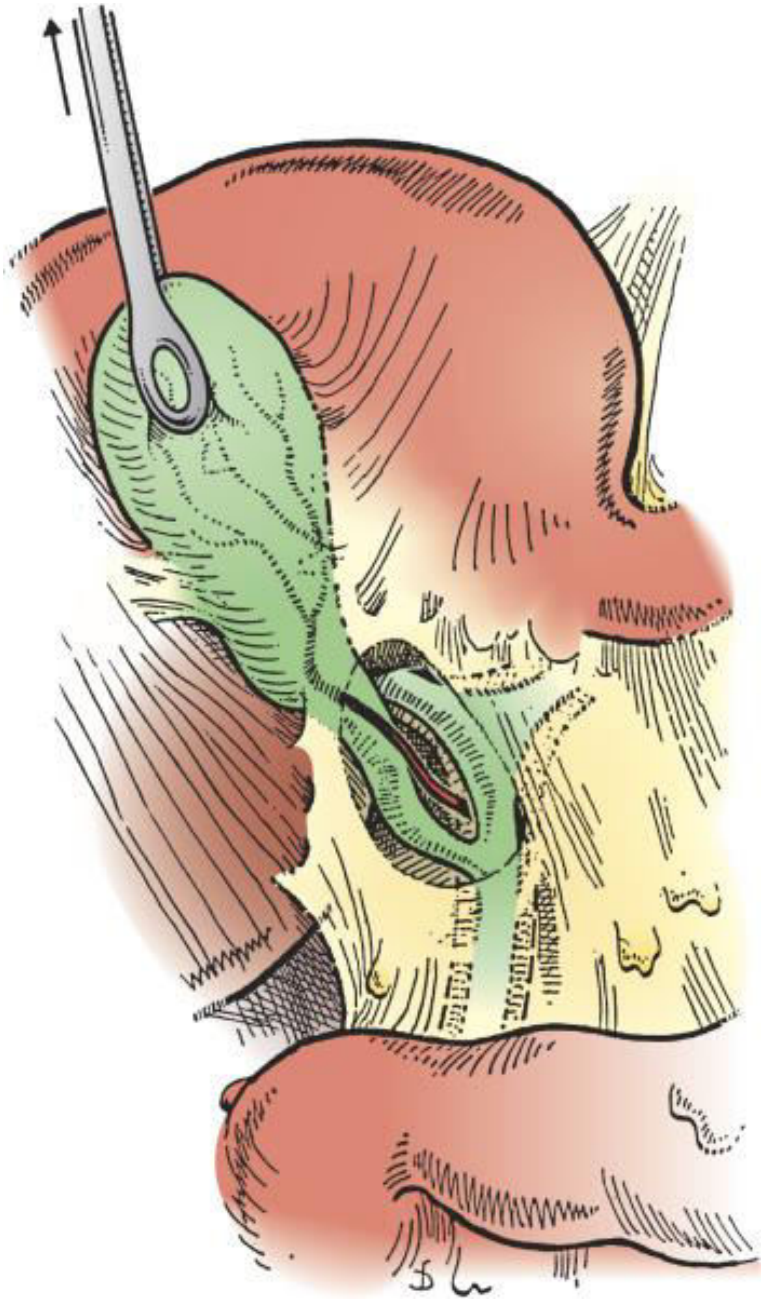
The fundus of the gall bladder is grasped with a clamp. A distended gallbladder will be difficult to grasp so it may be aspirated to

manipulate . During acute inflammation, there will be net secretion into the gallbladder with no excretion. This produces hydrops of the gallbladder.

There are two methods available to remove the gallbladder.

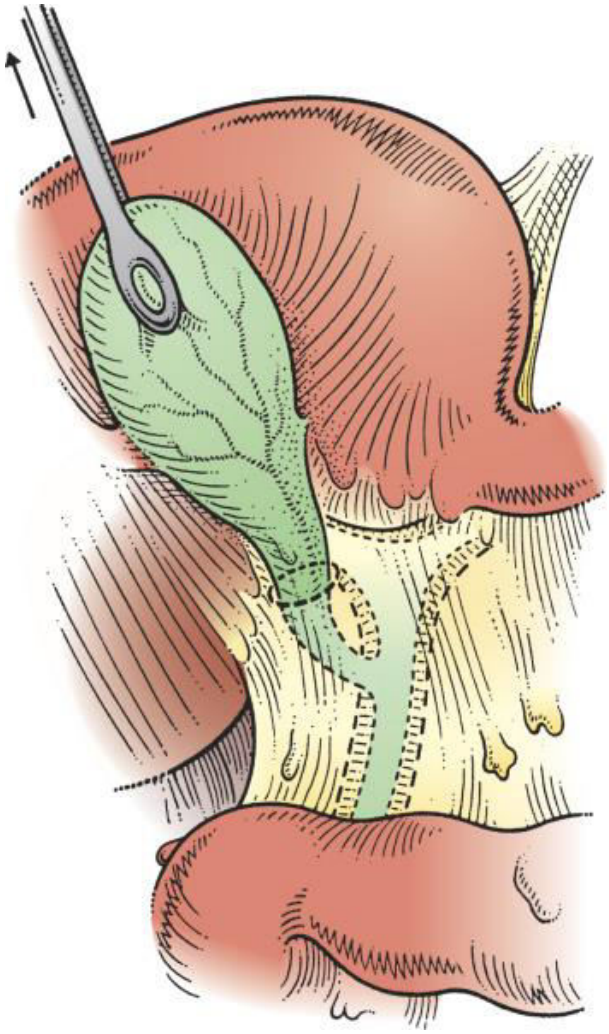
1. NECK TOWARD THE FUNDUS APPROACH

It is used for clear cut cases in which there is minimal or no inflammation and adhesions, and structures of the Calot's triangle are easily identifiable. In laparoscopic cholecystectomy this method is adopted usually . When there is intense inflammation and dense adhesions in which there is no clear visualization of the triangle components, the safest method is fundus toward the cystic duct.



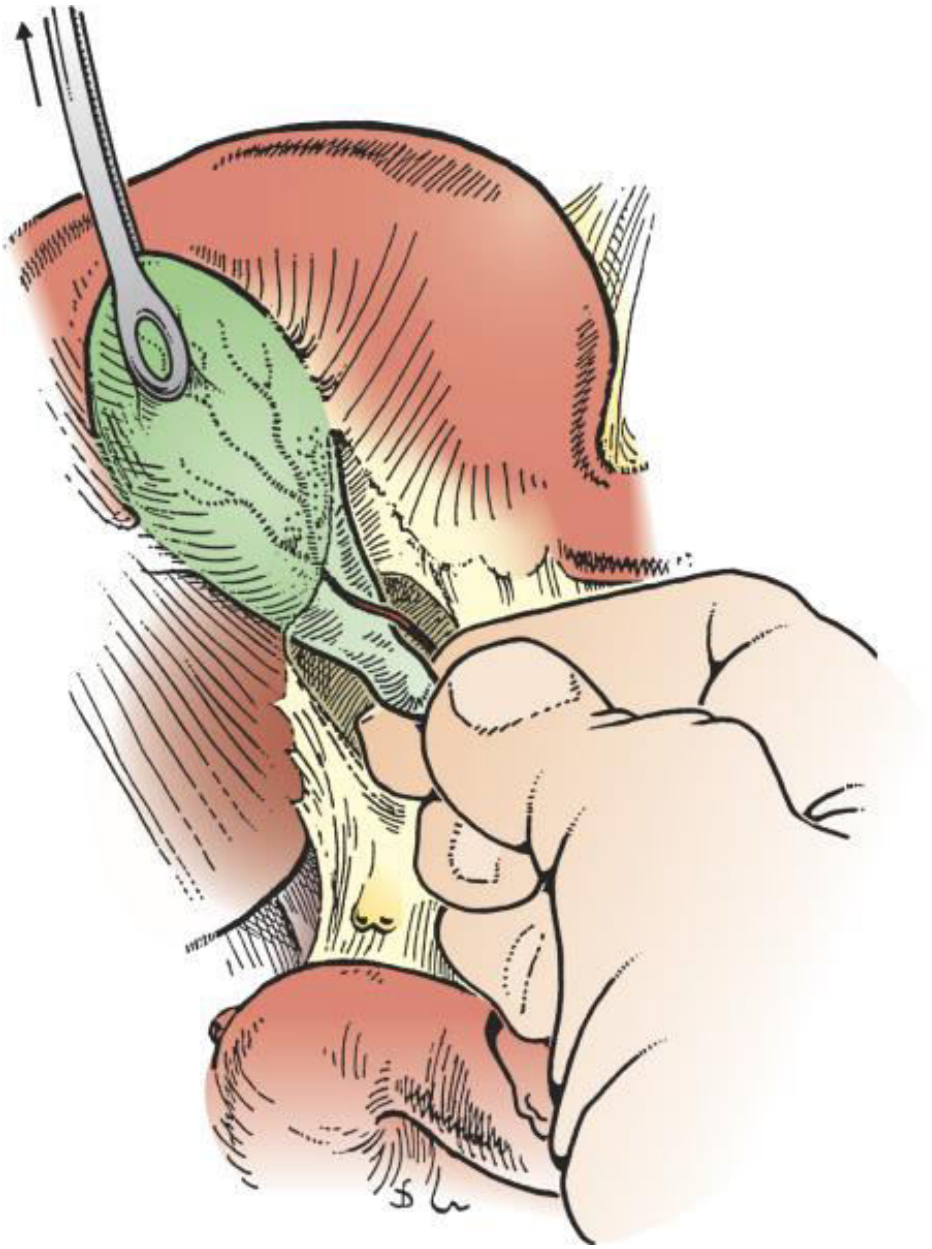
Incising the peritoneum overlying the hepatoduodenal ligament will expose Calot's triangle.

The surgery begins with incising the undersurface of the gallbladder and extending to the anterior aspect of the hepatoduodenal ligament . A grasper may be placed on the infundibulum of the gallbladder to give traction laterally and anteriorly so as to delineate the cystic duct away from the common bile duct. Blunt dissection of the triangle is performed to identify the cystic duct and its junction with the common bile duct. The surgeon has to palpate the duct and if any stones is identified it should be milked back up into the gall bladder.

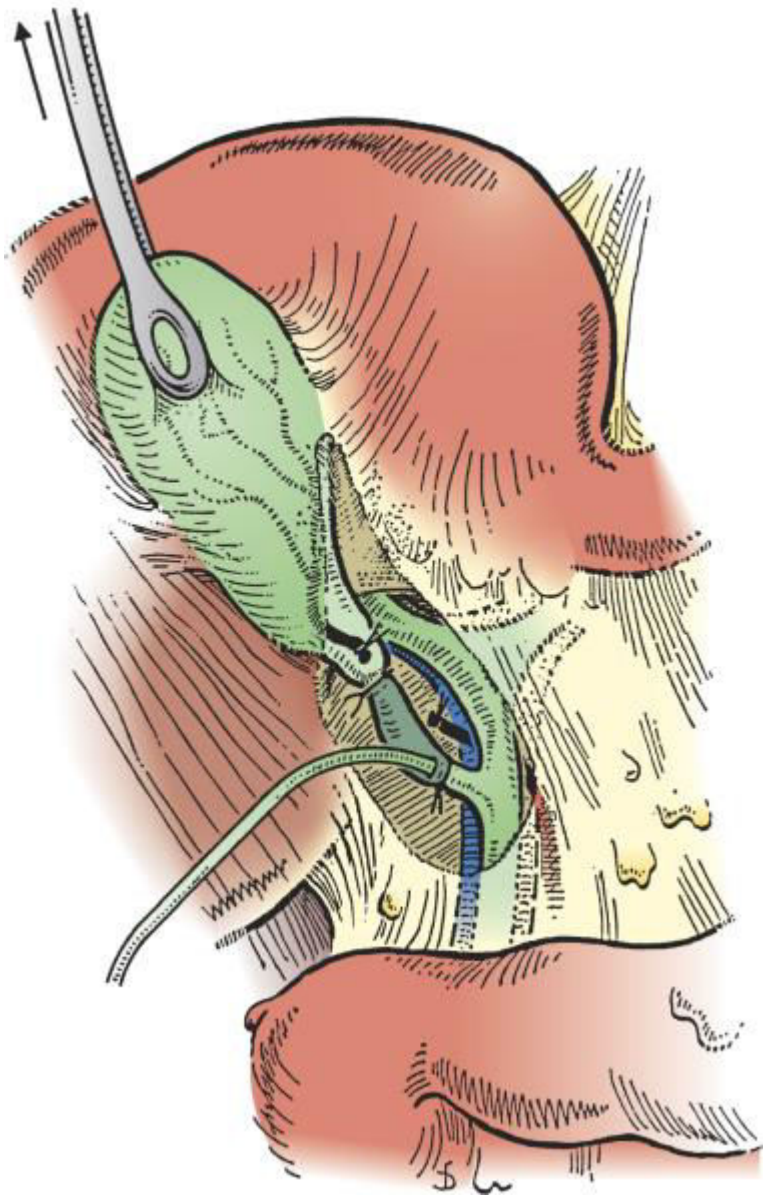


Cholecystectomy commences with adequate exposure of the gallbladder, grasping the fundus with a clamp to provide traction.

At this point an intraoperative cholangiogram is performed if available when there is a suspicion for a common bile duct stone . The common bile duct should be opened, if a stone is palpable within it or detected on cholangiogram and it should be removed.



The cystic duct is sharply divided between clamps as close as possible to the gallbladder to prevent injury to the common bile duct. The cystic artery lies superior to the cystic duct and it is dissected back to the gallbladder for confirmation. Once the cystic artery has been dissected and distinguished from a right hepatic artery, it is divided between clamps and doubly ligated.



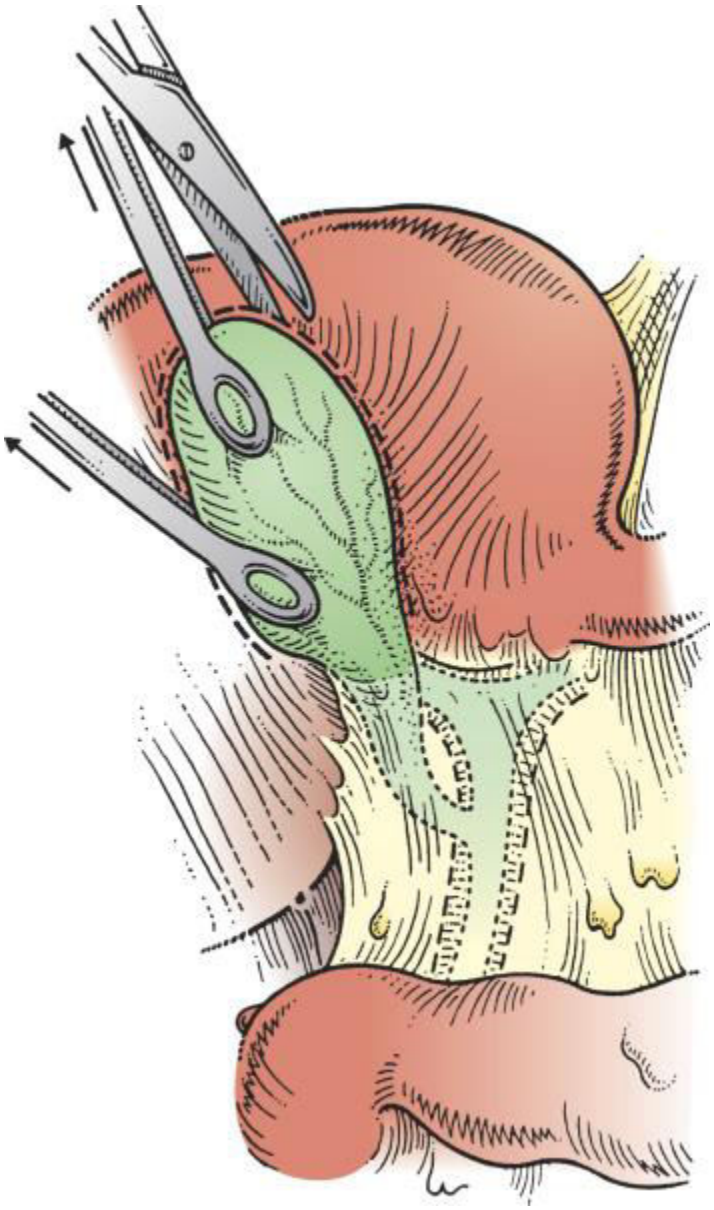
Intraoperative cholangiogram can be performed to identify anatomy or if a common bile duct stone is suspected.

After the cystic artery and cystic duct division , the neck of the gallbladder is now free and dissection of the gallbladder from its gall bladder fossa can be started. Cephalad traction on the neck of the gallbladder exposes the investing peritoneum around the gallbladder and the liver. The gallbladder is dissected from its fossa by sharp or blunt or using electrocautery. This continues in all margins until the gallbladder is free . Sometimes there may be aberrant bile duct branches(ducts of Luschka) from the right hepatic or common hepatic ducts communicating directly with the cystic fossa. These when present it should be recognized , clipped and divided. In cases of postoperative bile leak, these ducts often cease draining spontaneously. The liver bed is inspected for hemostasis

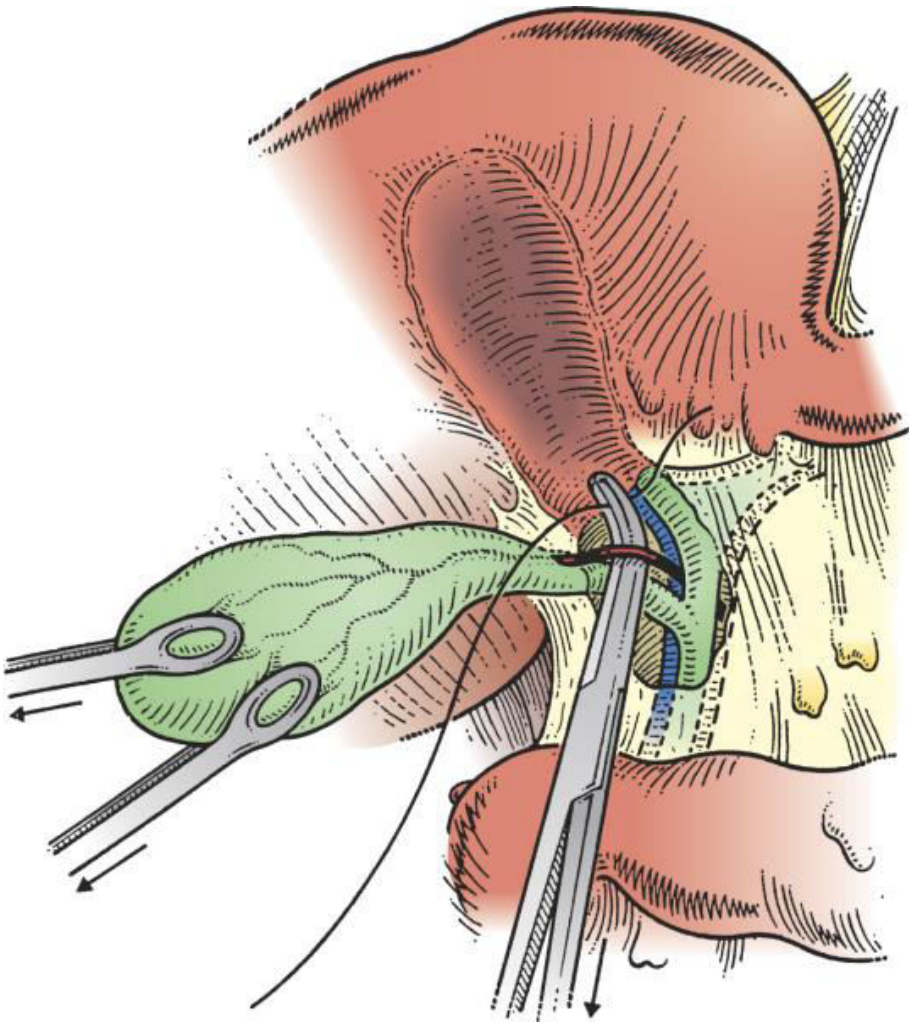
FUNDUS DOWN TECHNIQUE:

The fundus down method is especially useful in the cases of acute cholecystitis where there is dense adhesions and the neck of the gallbladder, cystic duct, cystic artery, and the hepatoduodenal ligament are obscured . In this technique the gallbladder is released from the liver first then the identification of ductal and vascular structures is done subsequently which reduces the rate of inadvertent injury to those structures.

An incision is made in the gallbladder serosa at the tip of the fundusand a subserosal plane is created between the gallbladder and the liver on both sides .The fundus is grasped with a clamp to give a caudal traction and the gallbladder is taken out of the fossa by sharp or blunt dissection.



When the neck of the gall bladder is reached, the cystic artery will be seen entering the gallbladder wall. The cystic artery is then divided between clamps and ligated. The cystic duct, common bile duct, and common hepatic duct should be identified subsequently .The cystic duct is then clamped and divided between clamps and ligated.



The gallbladder fossa is inspected for hemostasis. The use of a closed suction drain is only indicated if the surgeon is suspicious about bile leak. The drain is placed in the gallbladder fossa and brought out through a separate lateral stab incision. The abdominal incision is closed in layers.

MATERIALS AND METHODS

The study was conducted in the patients who underwent laparoscopic cholecystectomy from November 2011 to November 2012 in the department of general surgery, Government Stanley Hospital . There were totally 100 patients of which are males and are females. The study has been done after the patients informed consent . All these patients were evaluated in a proper manner as given in the proforma and have been assessed pre operatively and operated under perfect anaesthetic fitness.

This study mainly focusses on the patients who have been converted to open method . They were analysed further regarding the reasons for conversion to open method due to per-operative complications.

1. **INCLUSION CRITERIA:**

   i. All patients with syptomatic gallstone disease

   ii. Asymptomatic gallstone disease in patients with type 2 DM

   iii. Benign gall bladder disease like gallbladder polyp

2. **EXCLUSION CRITERIA:**

i. Patients who had undergone previous upper GI surgeries

ii. Patients with known liver diseases

3. METHODOLOGY :

- All patients admitted in SMC-GS ward with a diagnosis of cholelithiasis in the time period of November 2011 – November 2012 are included in this study. Thorough history and clinical examination was done.

- Admission baseline blood investigations was done. Liver function test was done in all patients.

- As per the standard protocol all patients were treated with medical and surgical care as available in institution.All patients were subjected to ultrasonogram abdomen and upper GI endoscopy .

- CECT abdomen was done in patients with suspected pancreatic/common bile duct pathology.

- MRCP was done in patients with elevated alkaline phosphatase and dilated CBD/associated CBD pathology.

- Consent regarding conversion if necessary was also obtained in all cases.

OBSERVATION AND RESULTS

From November 2011 – November 2012 , a total of 98 patients had undergone laparoscopic cholecystectomy in the Department Of General Surgery ,Government Stanley Hospital

Out of 98 patients who underwent laparoscopic cholecystectomy 13 patients (13.26 %) were converted to open cholecystectomy owing to per-operative complications .The reasons for conversions are listed in the **(Table 1and Chart 1).**

Of these 98 patients 36 were males and 62 were females, out of which 6 males and 7 females were converted into open cholecystectomy i.e.,6.12% males and 7.14% females of total cases .when taken in terms of number of males and females who got converted male and female percentage were 16.66% and 11.29% **(Table 2 and Chart 2)** respectively. The least age patient in our study is 16 and the highest age patient is 70. The conversion was higher in 40-50 age group (46.15% of total conversion) and was low in 30-40 age group (15.38% of total conversion) patients. Conversion was not done in 10-20 age group and 60-70 age group patients . highest number of patients who underwent

laparoscopic cholecystectomy were in 30-40 age group. **(Table 3 and Chart 3)**

All patients underwent cholecystectomy as an elective case . Though some morbidity was there in terms of post operative complications which we are not analyzing , no mortality was reported.

TABLE 1

REASONS FOR CONVERSION OF LAPAROSCOPIC CHOLECYSTECTOMY

REASONS	NO OF CASES	% OF TOTAL (98) CASES	% OF CONVERTED(13) CASES
DENSE ADHESIONS	5	5.10%	38.46%
DIFFICULT ANATOMY AROUND CALOT'S	3	3.06%	23.07%
ARTERIAL INJURY	3	3.06%	23.07%
HEPATO BILIARY INJURY	1	1.02%	7.69%
TECHNICAL PROBLEMS	1	1.02%	7.69%

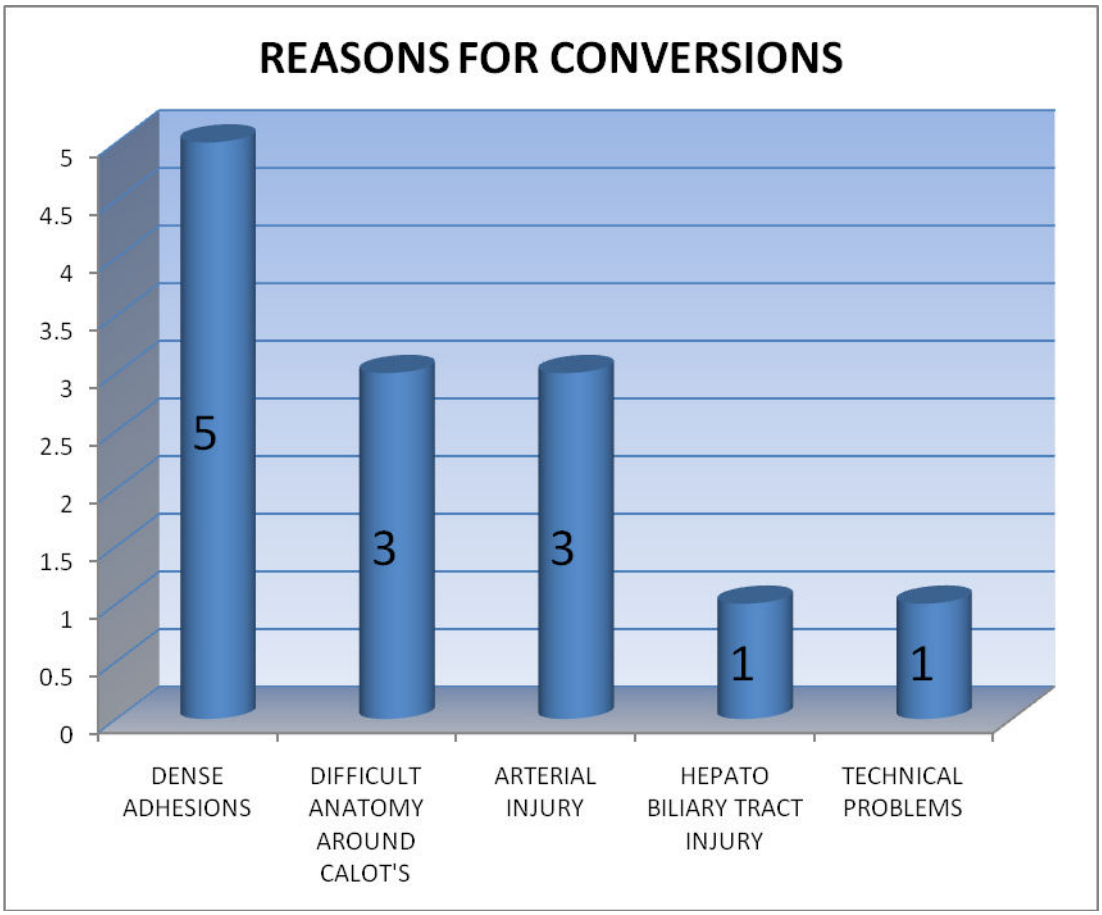


CHART – 1

This is the chart showing the reasons for conversion of laparoscopic cholecystectomy due to conditions arising per-operatively.

.TABLE – 2

INCIDENCE OF CONVERSION AMONG MALES AND FEMALES

	CONVERTED CASES	% OF TOTAL CASES
MALES	6	6.12%
FEMALES	7	7.14%

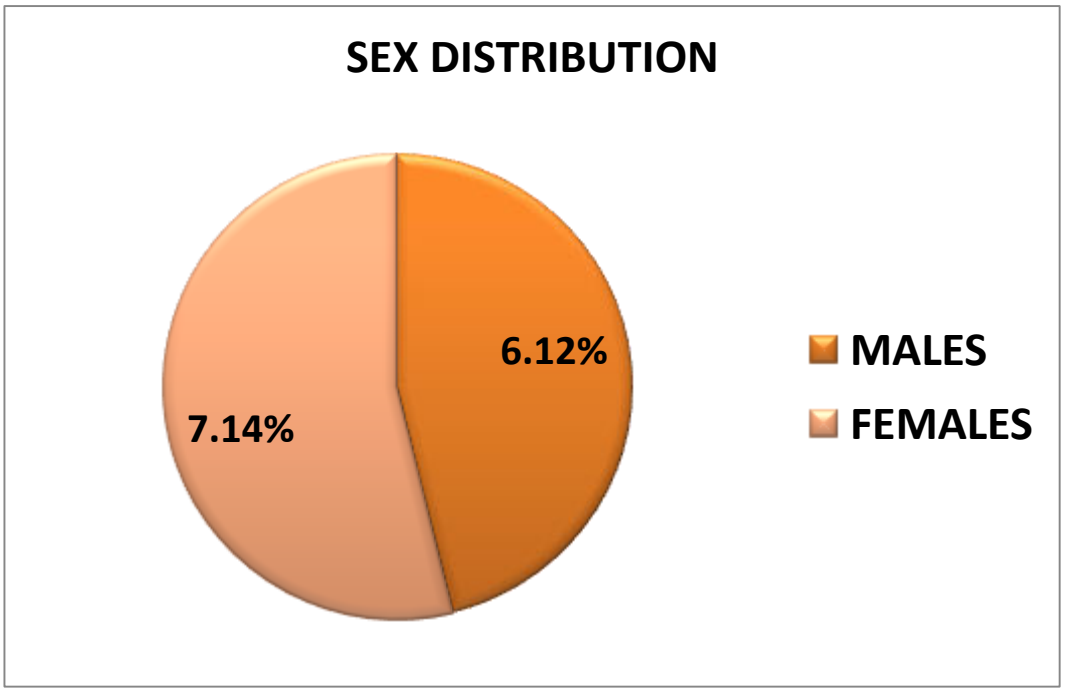


CHART - 2

TABLE – 3

CONVERSION OF LAPAROSCOPIC CHOLEYSTECTOMY AMONG VARIOUS AGE GROUPS

AGE GROUP	NUMBER OF CASES CONVERTED	% OUT OF CONVERTED CASES
10-20	0	0%
20-30	3	23.07%
30-40	2	15.08%
40-50	6	46.15%
50-60	2	15.38%
60-70	0	0%

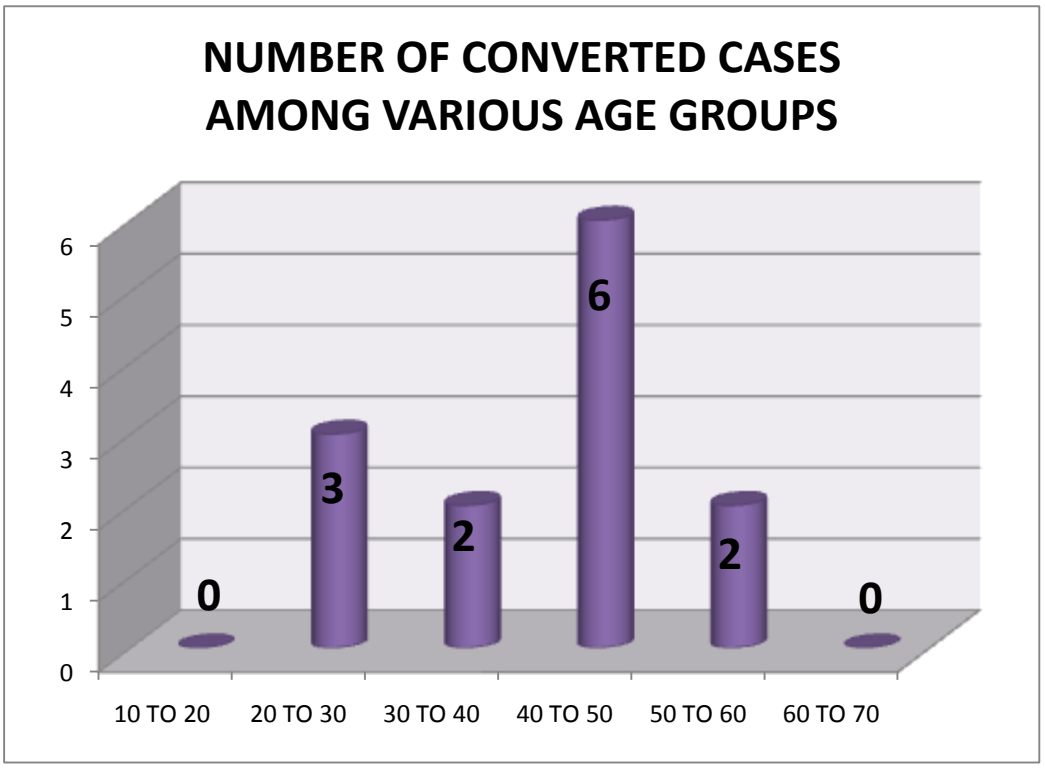


CHART - 3

DISCUSSION

Laparoscopic cholecystectomy is the gold standard treatment for cholelithiasis.the superiority of laparoscopic cholecystectomy over open method ha sbeen analysed and results were drawn in favour of laparoscopic cholecystectomy, even in developing countries like ours nowadays cholelithiasis is treated by laparoscopic method.

Studies from various countries reported a conversion rate of 5 to 14 %. In our study 98 patients were operated over a period of 1 year from november 2011- november 2012 and the conversion rate was 13.26%.several prospective studies done by **Michael Rosen et al, Singh Kuldip et al , H.J.J Van Der Steeg et al , Ajay Anand et al** have drawn results similar to our study.

Because of several and repeated analysis and research in this particular aspect of laparoscopic cholecystectomy , it should not be considered neither as a failure nor as an inexperience of the surgeon. It is for the safety and goodness of the patient conversions are being made and it is the only reason almost always.hence it should be emphasized that the conversion of laparoscopic cholecystectomy indicates accuracy and timely intervention of the surgeon.

By analyzing the data from our study the following events occuring during laparoscopic cholecystectomy may need conversion to open method. Some of the complications may be repaired laparoscopically by experienced hand and some of them definitely needs conversion.anyway . By all means it is the decision of the surgeon to decide conversion .

DENSE ADHESIONS :

The conversion of laparoscopic cholecystectomy due to dense adhesions in our study is 5.1% of total cases that were operated and is 38.46% of cases that got converted .even though the patients in our study have not undergone any previous upper abdomen surgeries, adhesions remained the most common cause for conversion. In all patients who got converted due to adhesions , laparoscopic adhesiolysis was tried initially and cases which failed to achieve adhesiolysis got converted.studies by **Nadim Khan et al, NEJM Surgical Study Group ,Saeed Hadi Al-Bahlooli** quoted that adhesions are the most common cause for conversion of laparoscopic cholecystectomy .in our study group , adhesions were found in 5 cases, of which adhesions between gall bladder and hepatic flxure of colcn was found in 1 case,gall bladder

and duodenum in 1 case, greater omentum and anterior abdominal wall in 2 cases,adhesions around porta hepatis in one case.

DIFFICULT ANATOMY AROUND CALOT'S TRIANGLE:

The conversion of laparoscopic cholecystectomy due to difficult anatomy around calot's triangle in our study is 3 case (3.06%). Of total cases that were operated and is 23.07% of cases that got converted . The conversion of laparoscopic cholecystectomy is extremely important when there is difficult anatomy around calot's triangle as there is more chance of bile duct and cystic artery injury in this situation. In studies by **Malla B R , Muhammed Shamim et al , S K Biswas Et Al , Vikas Gupta et al** , it was concluded that the conversion of laparoscopic cholecystectomy due to difficult anatomy around calot's triangle is the most common cause for conversion of laparoscopic cholecystectomy . Anatomy can get altered due to any cause like acute cholecystitis, aberrations in cystic artery , right hepatic artery, common hepatic duct and common bile duct.in our case series there was excessive fat near the calot's triangle in two cases , cystic artery identification was difficult in one case due to adhesions around calot's triangle .

ARTERIAL INJURY:

The conversion of laparoscopic cholecystectomy due to arterial injury in our study is 3 case (3.06%) of total cases that were operated and is 23.07% of cases that got converted . It is one of the most important cause for conversion as it produce immediate hypotension and even death if immediate intervention was not done .usually laparoscopic repair of the bleeding site is not done because the field will become messed up with blood and most of the times it is impossible to identify the bleeding vessel in such a situation. Therefore only option that saves the patient in such condition is conversion .blind application of clips or cauterization in unclear area is absolutely contraindicated, because of the potential danger of misplacing the clips or cautery to vital structures the results of which may go hazardous to the patients life.in our study cystic artery was injured in two cases because of difficult dissection near calots triangle and 1 case is due to aberrant origin of cystic artery from common hepatic artery. Another case is converted due to torrential bleeding from the liver bed after dissection of the gall bladder .

HEPATO-BILIARY INJURY:

The conversion of laparoscopic cholecystectomy due to hepato-biliary injury in our study is 1 case (1.02%) of total cases that were operated and is 7.69% of cases that got converted .nadim et al and studies by surgical study group nejm concluded that hepato biliary injury also plays an important role in conversion of laparoscopic cholecystectomy.it occurs mostly due to blind dissection near calots when anatomy is unclear .it requires high level of expertise and experience to identify hepato biliary injury as most of the times it is not identified per operatively and diagnosed only in the post operative period . But when there is suspicion intra operatively , cholangiogram is to be done whenever there is a possibility and repair to be done in the most appropriate way.at any cost bile leak should be prevented as it possess a significant level of mortality when it causes biliary peritonitits.

TECHNICAL ISSUES:

The conversion of laparoscopic cholecystectomy due to technical issues in our study is 1 case (1.02%) of total cases that were operated and is 7.69% of cases that got converted.very few of the conversions are due to technical issues like poor lighting, insuffalator defects, unclear monitor/ cameras, defective dissectors / graspers,diathermy handles. Conversion due to technical issues are going down even in the developing countries like ours . It assumes importance because it is one of the easily correctable causes to avoid a conversion . Studies from the eastern part of the world showed technical issues as a reason for conversion in some of the cases. In our study one case got converted to open technique because of the problem with insuffalator and non replacement can be done at that time and hebce proceeded to open method even before the dissection of gall bladder and cystic duct, artery.it is entirely hazardous to operate with defective instruments and conversion is the better option in terms of patient safety.

Though many studies have drawn results citing inferior vena cava injury, portal vein injury,hepatic artery injury, bowel injury , incidental intra operative diagnosis of gall bladder and cholangiocarcinoma, cirrhosis liver as the causes for conversion , we have not encountered

any those situation and thus not included or explained in this study.but these conditions are also extremely important and conversion of laparoscopic cholectstectomy is needed in almost all cases of above said conditions.

Again it is highlighted that the conversion of laparoscopic cholecystectomy should be viewed as a good cause in terms of patient safety rather than as a failure in terms of the surgeon skills.

CONCLUSION

After analyzing the results of our study,

- We conclude that the incidence of conversion of laparoscopic cholecystectomy is **13.26 %.**
- The reasons for conversion in descending order of frequency are

1. Dense adhesions **(5.1%)**

2. Difficult anatomy around calot's triangle **(3.06 %)**

3. Arterial injury **(3.06 %)**

4. Hepato-biliary injury **(1.02 %)**

5. Technical issues **(1.02 %) .**

NAME	AGE	SEX	IP NO	CONVERSION	ARTERIAL INJURY
PRIYA	25	F	4127	YES	
VALLIAMMAL	52	F	42388		
KALPANA	27	F	44405		
THANSIVA	48	M	42684		
SULOCHANA	57	F	44850		
LAKSHMI	16	F	45286		
KANDASAMY	59	M	43835		
GOWRI	50	F	4387	YES	
AMEENABEE	56	F	44183		
VEMBU	48	M	45321		
DURGADEVI	26	F	1935		
KAVINISHA	48	F	2095		
MUSTAQ	47	M	2080	YES	
VASANTHA	44	F	2232		
BALAMANI	64	M	2237		
ASHIQ	43	M	4180		
GEETHA	35	F	10092		
GAJALAKSHMI	39	F	3949		
GOWRI	50	F	4387		
JASMINE	45	F	5140		
SHANMUGAM	60	M	11211	YES	
RASIGABEGUM	55	F	39760		
MAHALAKSMI	25	F	37231		
SAGAYAM	28	F	15873		
VALLIAMMAL	55	F	36702		
VENKAT	68	M	36236		
RANI	50	F	35349		
SOUNDARYA	34	F	17957	YES	
VASANTHA	59	F	30842		
SHALINI	35	F	29639		
KANNAN	32	M	26665		
BUVANESHWARI	28	F	40439	YES	
RAMAN	25	M	27218		
MERCY	25	F	26865		
SAMABEGAM	37	F	25974		
PORKODI	51	F	27026		
LOGU	37	M	41287	YES	YES
SELVAM	37	M	26306		
DEVAPILLAI	60	F	25963		
ANITHA	30	F	25964		
FATIMA	25	F	24760		
KAANIKAI	24	M	20812		

LEELAVATHY	49	F	4546	YES	
JESUDAS	20	M	22817		
RENUKA	34	F	20390		
ANJALAI	32	F	20450		
NAVEEN	30	M	19282		
JAYAPRIYA	36	F	19182		
SUBBU	26	F	18221		
ELUMALAI	64	M	17167		
SHANMUGAM	64	M	17162		
ARUMUGAM	47	M	40815	YES	
REVATHY	26	F	16039		
SALIMA	69	M	10321		
HABUB	60	F	10480		
GEETHA	35	F	10092		
VEMANNA	56	M	8369		
PARTHASARATHY	56	M	9046		
PUSHPA	45	F	8839		
RAGAVAN	44	M	4388	YES	YES
POPPY	41	F	8817		
AMUDHA	30	F	8142		
PUSHPA	42	F	8182		
PONNUSAMY	55	M	7510		
SIVAGAMY	63	F	6348		
DEEPA	27	F	5349		
KARPAGAM	26	F	5356		
SAMEEER	50	M	4089		
JANAKI	70	F	2415		
KALYANI	45	F	4440	YES	
SANTHIYA	35	F	43022		
THAMARAI	48	F	41491		
SKRAJA	44	M	43594		
KAGARNISHA	38	F	42493		
PADMA	37	F	43473		
PRABAKAR	30	M	42603		
RAMALINGAM	58	M	10190	YES	YES
ANURADHA	32	F	42151		
CHINNAPA	38	M	41746		
MUNIYAMMA	55	F	40908		
MADHAN	35	M	3921		
GOVINDAMMAL	50	F	41772		
SAROJA	60	F	38884		
KATEEJA	38	F	39493		
GULSARBEE	50	F	38552		
SAMANTY	34	F	40619		

RAJESH	**34**	**M**	**41214**	
ARUMUGAM	**47**	**M**	**40815**	
DURGA	**26**	**F**	**1935**	**YES**
ABDUL	**38**	**M**	**51465**	
SENGUTTUVAN	**53**	**M**	**49997**	
SELVI	**38**	**F**	**52742**	
BANU	**59**	**F**	**51402**	
DASS	**62**	**M**	**51694**	
KALAIVANI	**17**	**F**	**51005**	
SUMATHY	**38**	**F**	**49175**	
MANIKUMAR	**50**	**M**	**49046**	
ASAITHAMBI	**35**	**M**	**50324**	

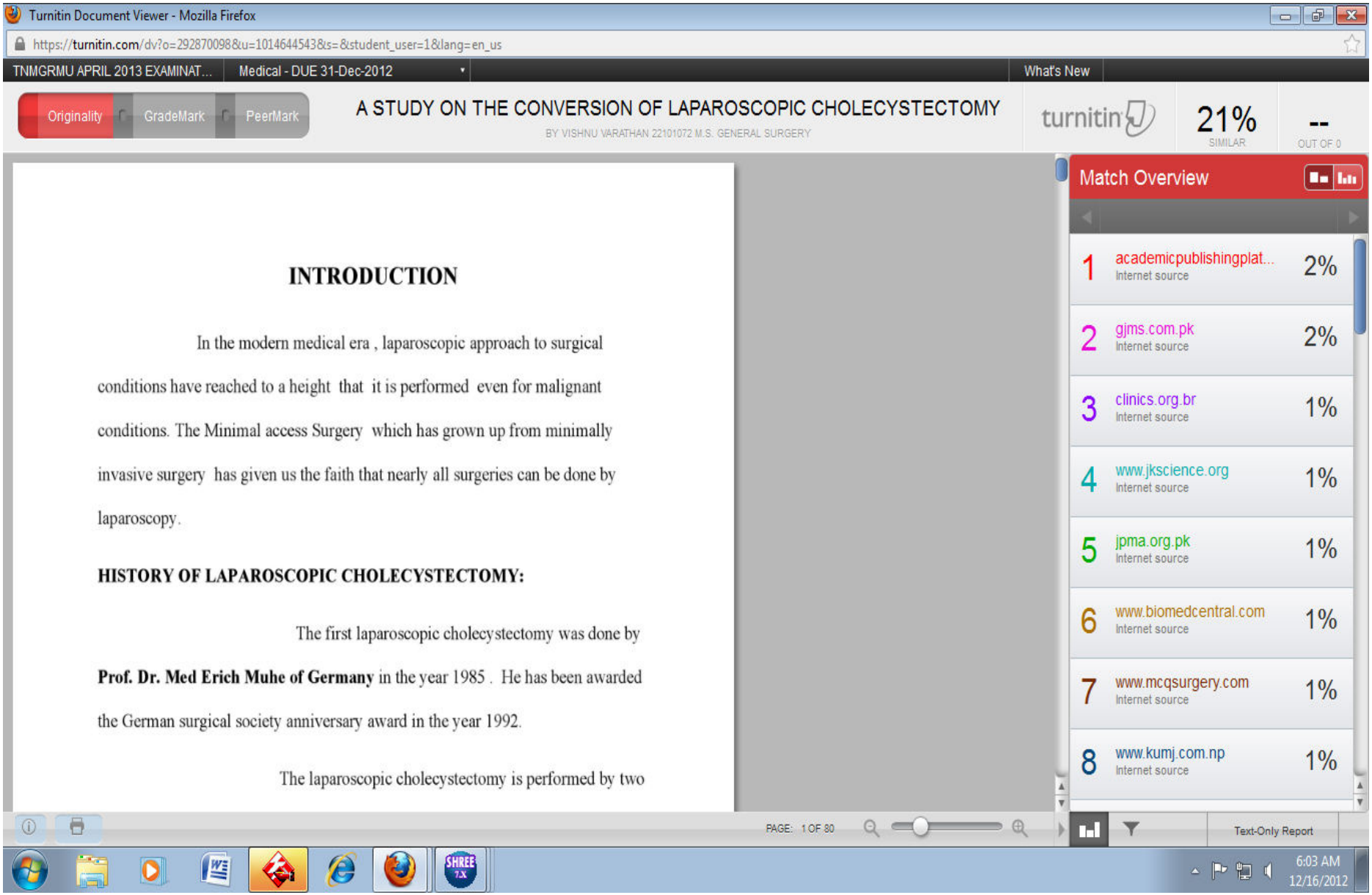
HEPATO BILIARY INJURY	ADHESIONS	ABERRANT ANATOMY	TECHNICAL ISSUES
	YES		
	YES		
		YES	
	YES		
	YES		
		YES	

YES

YES

YES

YES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INTRODUCTION
In the modern medical era , laparoscopic approach to surgical conditions have reached to a height that it is performed even for malignant conditions. The Minimal access Surgery which has grown up from minimally invasive surgery has given us the faith that nearly all surgeries can be done by laparoscopy.
HISTORY OF LAPAROSCOPIC CHOLECYSTECTOMY:
The first laparoscopic cholecystectomy was done by Prof. Dr. Med Erich Muhe of Germany in the year 1985 . He has been awarded the German surgical society anniversary award in the year 1992.
The laparoscopic cholecystectomy is performed by two
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