

## Laparoscopic Cholecystectomy

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### Abstract

Laparoscopic Surgery is an expanding field of diagnostic and surgical therapy. Philippe Mouret is credited with the first Laparoscopic cholecystectomy in 1987. Laparoscopic Cholecystectomy is now considered as the gold standard in the treatment of gall bladder disease. The aim of this Chapter publication is to highlight the indications and contraindications of Laparoscopic Cholecystectomy including the advantage of the procedure. Preoperative preparation will be mentioned and a detailed description of the operative protocol of Laparoscopic cholecystectomy will be analyzed. Also post-operative complications of the Surgery of Laparoscopic cholecystectomy will be elaborated including ways to avert and manage the complications. Laparoscopic Cholecystectomy is the most commonly performed minimal access surgery by general surgeon's worldwide. In Europe and America 99% of all the Cholecystectomy is performed by Laparoscopy. The award of excellence of less invasive surgery is to Laparoscopic Cholecystectomy. However, in the developing countries, it is a relatively new area. Challenges encountered in the developing countries include power failure, equipment failure and difficult dissection due to the usage of less potent energy sources. Despite this myriads of challenges posed by such a novel technique Laparoscopic surgery can be safe, feasible and effective, even in a resource poor setting. However in time to come, it will be expedient to provide more Laparoscopic facilities and a dedicated theatre suit and train more personnel in order to upgrade the range of procedures, that can be performed in the developing world.

**Keywords:** Laparoscopy; Cholecystectomy; Gall Bladder; Ports; Complications

### Section I: Introduction

It was in 1987 that Mouret performed the first Laparoscopic cholecystectomy. currently laparoscopic cholecystectomy is the gold standard in the treatment of gall bladder disease. It is the most commonly performed minimal access surgery by general surgeons worldwide. Though not exactly so in the developing world but more so in the developed world like Europe and America where almost all cholecystectomy is done laparoscopically. Laparoscopic cholecystectomy has glorified minimal access surgery and in modern day remains the most accepted minimal access surgical

procedure the world over. This has led to the use of laparoscopy to tackle other indicated intradominal surgical conditions.

Indications of laparoscopic cholecystectomy include the following:

- Cholelithiasis
- Cholesterosis
- Mucocele of the gall bladder
- Emphyema gall bladder
- Typhoid carrier

- Porcelain gall bladder
- Gall bladder polyps
- As part of Whipples procedure
- Gall bladder carcinoma
- Clonorchis sinensis gall bladder

The absolute contraindications to laparoscopic cholecystectomy will include.

Multiple previous abdominal surgeries with severe adhesions

- Late pregnancy
- Abdominal wall infections
- Severe cardiopulmonary disease
- Generalized peritonitis
- Uncorrected coagulopathy
- Haemodynamic instability
- Sepsis including cholangitis.

Relative contra-indications included;

- Previous upper abdominal surgery
- Acute cholecystitis
- Choledocolithiasis
- Gallstone pancreatitis
- Co-existent carcinoma, diverticular and inflammatory bowel disease
- Cirrhosis
- Significant anaesthetic risk
- Minor bleeding disorder (e.g. aspirin intake).
- Pregnancy
- Obesity.

Advantages of Laparoscopic cholecystectomy

- Cosmetically better than open surgery
- Less disruption of tissue planes and less tissue dissection
- Post-operative pain is reduced
- Reduced intraoperative and post operative complications in experienced hand
- Early return to work

## Section II: Preoperative preparation of the patient

### Routine investigations

- Complete blood count
- Serum electrolyte urea and creatinine
- Urinalysis
- Serology-HbsAg, HBC, HIV
- Fasting blood sugar
- Liver function test
- Clothing profile
- Imaging-ultrasound, CT-scan
- In some centers, intravenous cholangiography may not be confirmative and is attended with the risk of anaphylactic reactions.

Patient is positioned on the operating table with a steep head up and left tilt. This is done once pneumoperitoneum has been established. The patient is placed in reverse Trendelenburg position and rotated to the left to give maximal exposure to the right upper quadrant.

The surgeon stands on the left side of the patient with the scrub nurse - camera holder- assistant. One assistant will stand right to the patient and should hold the fundus grasping forceps.

For the procedure the following are needed;

- A high flow insufflator (with smoke filter) that can deliver 4 litres/min in order to maintain pneumoperitoneum.
- A video camera attached to or incorporated into a 10 mm laparoscope. The pictures are relayed on a TV monitor.
- Two 10-11 mm cannulas for the Laparoscope and operating instruments and 2,5 mm cannulas for the grasping instruments.

## Section III

Pneumoperitoneum is achieved with several litres of CO<sub>2</sub> gas using the veress needles through the umbilicus. The process of inserting the veress needle involves giving a stab immediately below the umbilicus. Veress needle should be held like a dart. To avoid both difficulty ( creation of pre-peritoneal space and injury to bowel or great vessels), the lower abdominal wall should be lifted in such a way that it should lie at 90° angle in relation to

the veress needle but in relation to the body of the patient veress needle will be at an angle of 45° pointed towards the anus. Lifting of abdominal wall should be adequate so that the distance of abdominal wall from viscera should increase. If less than required dose of muscle relaxant is given in muscular patient, lifting of lower abdominal wall is may be difficult. In multipara patient, lifting lower abdominal wall is very easy. Indicators of safe veress needled insertion included:

- Needle movement test
- Irrigation test
- Aspiration test
- Hanging drop test.

Once the veress needle is well placed inside the peritoneal cavity pneumoperitoneum is instituted. For safe access, surgeon should always see carefully all the four indicators of insufflator at the time of creation of pneumoperitoneum. The quadro-manometric indicators are the four important readings of insufflator

- Preset insufflation pressure
- Actual pressure
- Gas flow rate
- Volume of gas consumed.

If the gas is flowing inside the abdominal cavity, there should be proper proportionate rise in actual pressure with total gas used. With the entry of 400 to 500ml of gas if actual pressure is equal to preset pressure of 12 mmHg, that means gas is not going in freely into the abdominal cavity. It may be in the preperitoneal space or inside the omentum or may be in the bowel. If gas is pumped more than 5 litres without any distension of the abdomen, that means gas leakage or gas may be going into the vessel.

#### Section IV: Port position of laparoscopic cholecystectomy and laparoscopic anatomy

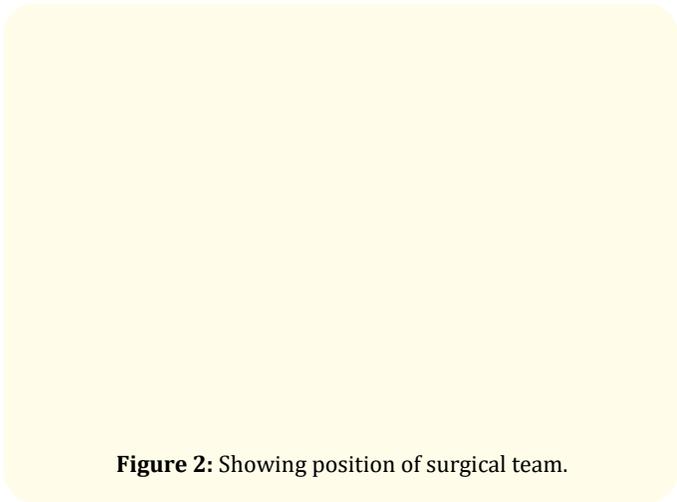
Conventionally, there are 4 port positions though 3 port Cholecystectomy has been done. The 4 ports are: Optical (10 mm), one 5 mm and one 10 mm operating, and one 5.0 mm assisting port. The optical port is at or near the umbilicus and routinely at 30 degree Laparoscope is used. The Laparoscope is inserted through a 10 mm umbilical port and the abdominal cavity is explored for any obvious abnormalities. With the aid of the Laparoscope the secondary ports are then placed under direct vision. The surgeon

then places a 10 mm trocar in the midline and left to the falciform ligament at the epigastrium. Two 5 mm ports are; one subcostal trocar in the right upper quadrant and another 5 mm trocar lower, near the right anterior axillary line are placed.

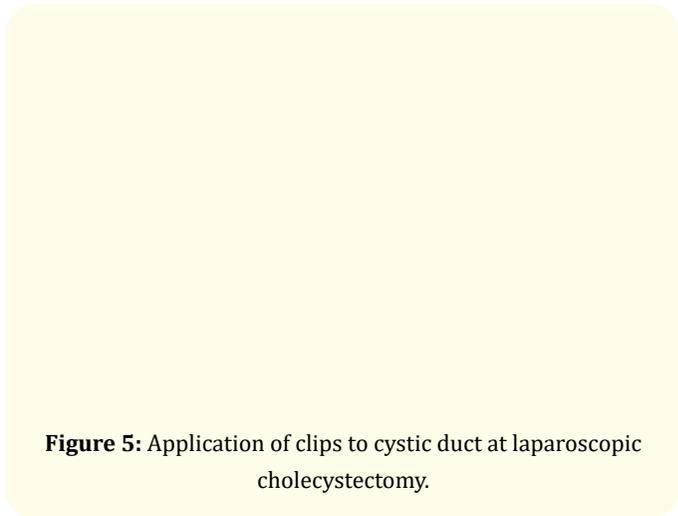
Laparoscopic view of the right upper quadrant on first look will demonstrate primarily the subphrenic spaces, abdominal surface of diaphragm and diaphragmatic surface of the liver. The fundus of the gallbladder can be seen popping from the inferior surface of the liver. The falciform Ligament is seen as a prominent dividing point between left subphrenic space and the right subphrenic space. As the gall bladder is elevated and retracted towards the diaphragm, adhesion to the omentum or duodenum and transverse colon is seen.

Three port cholecystectomy. The fourth (lateral) trocar is used to grasp the fundus of the gall bladder, so as to expose Calot's triangle. It has been argued that the fourth trocar is not necessary in most cases. The three-port techniques is as safe as the standard four-port. The main advantages of the three port technique are that it causes less pain, is less expensive and leaves fewer scars. The three port cholecystectomy should be done in good hands because left hand manipulation is key. More Laparoscopic surgeons with versatile experience will continue to engage in the operation of three port Laparoscopic Cholecystectomy.

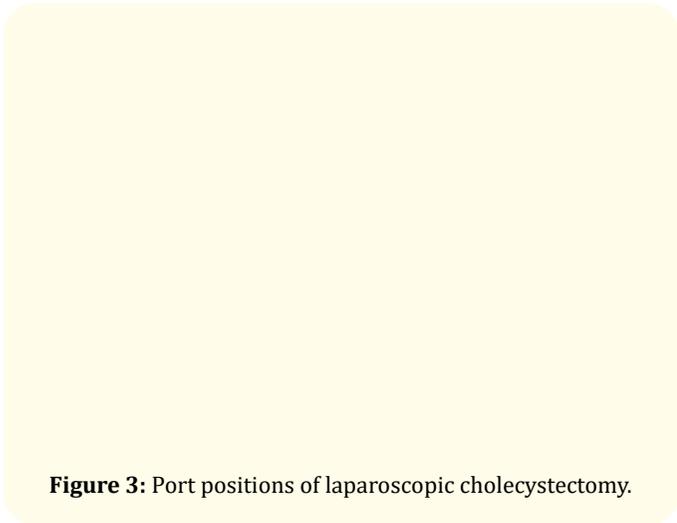
**Figure 1:** Showing anatomy of the calots triangle.



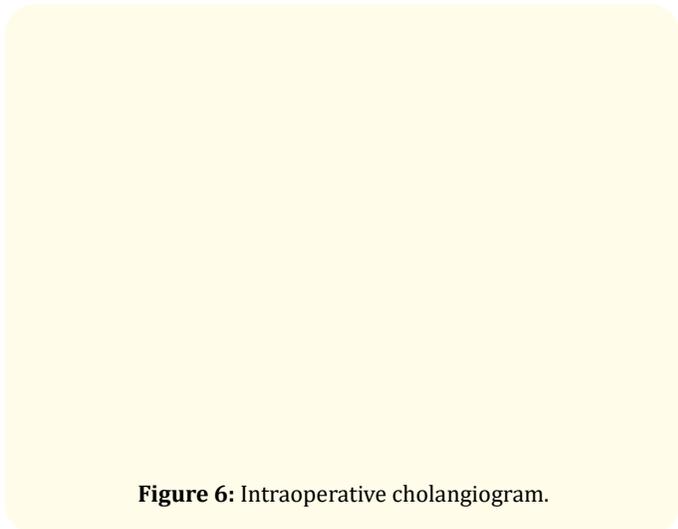
**Figure 2:** Showing position of surgical team.



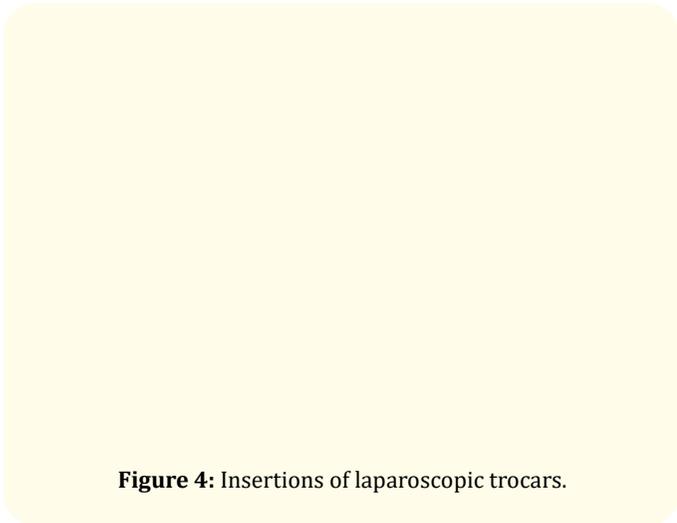
**Figure 5:** Application of clips to cystic duct at laparoscopic cholecystectomy.



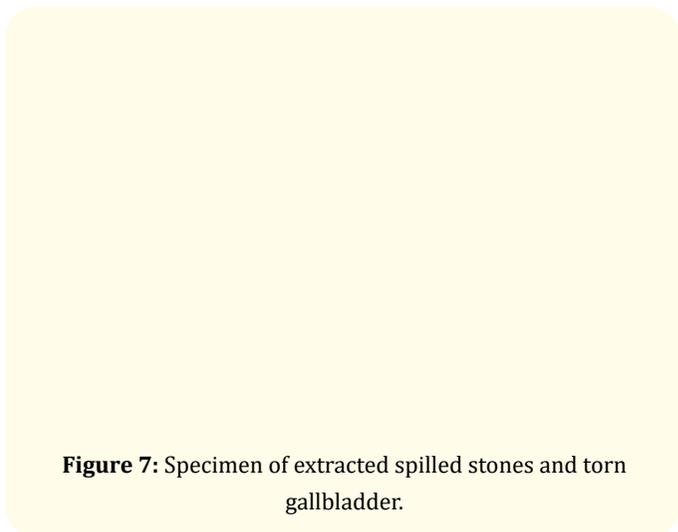
**Figure 3:** Port positions of laparoscopic cholecystectomy.



**Figure 6:** Intraoperative cholangiogram.



**Figure 4:** Insertions of laparoscopic trocars.



**Figure 7:** Specimen of extracted spilled stones and torn gallbladder.

**Section V: The procedure of laparoscopic cholecystectomy, this include:**

- Exposure of Gallbladder and cystic pedicle
- Adhesiolysis
- Dissection of the cystic pedicle
- Separation of cystic duct from artery
- Clipping and division of cystic duct
- Ligation of the cystic duct
- Extraction of the gall bladder
- End of surgery - The instrument and ports are removed.

Telescope is removed leaving gas valve of umbilical port open to let out all the gas. At the time of removing umbilical port, telescope should be reinserted and umbilical port removed over the telescope to prevent any entrapment of omentum. The wound is then closed with sutures. Many Laparoscopic surgeons leave this fascial defect without ill defect and in addition inject local anesthetic agent over port site to avoid post operative pain. Sterile dressing is applied over the wound. Laparoscopic Cholecystectomy for acute cholecystitis when done within the first 72 hours of symptoms onset leads to reduction in: operative difficulty, conversion rate and operative time.

Laparoscopic Cholecystectomy during Pregnancy - This is possible during the second trimester of pregnancy, where the operative risks are considered to be the lowest.

Operative Cholangiogram - Routine Cholangiogram decreases the risk of common bile duct injury in case of difficult anatomy as it delineates the biliary anatomical variations at risk for bile duct injury. It also would help in detecting common bile duct stone and will also lead to a reduction of the incidence of residual common bile duct stone.

The failure of Laparoscopic cholangiogram is due to;

- The narrowness of the cystic duct
- Cystic duct rupture
- Obstructive cystic values
- Impacted Cystic stones
- Dye extravasation from cystic duct perforation.

Successful Laparoscopic intra operative cholangiogram can be achieved in 90-99% of cases, a rate similar to that of intraoperative cholangiogram during open cholecystectomy.

**Intra operative ultrasonography**

The advantages of intraoperative ultrasonography over intraoperative cholangiogram are: Speedy, safer, multiple time use, economical.

The disadvantage of intraoperative ultrasonography is that it is impossible to provide extended views of the intrahepatic and extrahepatic biliary tree, difficult to show passage of contrast into the duodenum and to identify bile duct injuries.

In summary, Task Analysis of Laparoscopic Cholecystectomy include;

- Preparation of the patient
- Creation of Pneumoperitoneum
- Insertion of ports
- Diagnostic Laparoscopy
- Dissection of visceral peritoneum
- Dissection of Carlo's triangle
- Clipping and division of cystic duct and artery
- Dissection of gall bladder from liver bed
- Extraction of gall bladder and any spilled stone
- Irrigation and suction of operating field
- Final diagnostic laparoscopy
- Removal of the instrument with complete exit of CO<sub>2</sub>
- Closure of wound.

**Post operative care**

The patient who has urinary retention, prolonged nausea, more pain or difficulty in walking can be discharged after appearance of bowel sound. Usually patients are discharged next day of surgery. Preoperative broad spectrum antibiotics cover is administered, an hour before surgery, second and third doses should be administered on consecutive days after surgery. There may be a complaint of pain over tip of shoulder after Laparoscopic surgery. This is due to irritation of diaphragm from Co<sub>2</sub>. Analgessics are given for this. Most patients resume normal activities within 48 to 72 hours after surgery.

There could be variations in cystic artery and hepatic duct.

## Section VI: Complications of laparoscopic cholecystectomy

### Early complication

Retained stones and abscess formation, Haemorrhage, injury to viscera, bile leak, common bile duct injury. Late complications include biliary strictures and cystic duct clip stones.

The incidence of iatrogenic CBD injury is 0.12 and 0.55% during open and Laparoscopic cholecystectomy respectively. Common causes of common bile duct (CBD) injury include: misinterpretation of anatomy -70%, technical errors, surgeon operates on image rather than reality.

Surgeon should not dissect the Cystic duct if there is lack of initial identification and memory of key structure to the point of absolute certainty. Most important technical error is hilar bleeding and frantic attempts are made to control bleeding by electrosurgery. This frantic attack can catch the CBD and then injure it. In case of bleeding, the surgeon should first apply pressure and if it didn't stop suction irrigation and atraumatic grasper is applied to find out exact point of bleeding. Electrosurgery is used only when bleeding point is identified.

### Type of common bile duct injury

#### Bismuth classification

- Type 1 - Common hepatic duct stump >2 cm
- Type 2 - Common hepatic duct stump < 2 cm
- Type 3 - Hilar, right and left duct confluence intact
- Type 4 - Hilar separation of right and left ducts
- Type 5 - Injury to aberrant right duct plus or minus common bile duct injury.

If complication of CBD injury is recognized intraoperatively reconstructive surgery should be performed same time if surgeon has sufficient experience. For high complete transection Roux-en-Y hepaticojejunostomy is preferred. For lower complete injuries primary suture repair over T tube is better but long end of T tube must not be exteriorized from same site [1-20].

For partial injuries, insertion of T tube and Roux-en-Y serosal patch should be thought.

Method of managing complications recognized post operatively:

- Ultrasonography, endoscopic retrograde cholangiopancreatography (ERCP) plus magnetic resonance cholangiopancreatography are done.
- Fluid and electrolyte and systemic antibiotics are administered.
- Conservative treatment and biliary drainage for 6 weeks is done by either ERCP stent insertion or percutaneous transhepatic biliary drainage (PTBD) if endoscopic stent application is not possible.
- After several weeks: Reconstructive surgery
- Roux-en-Y choledocoduodenostomy or hepaticojejunostomy.

All the variation of cystic duct and artery should be memorized to avoid inadvertent injury of CBD.

### How to avoid injury

- Tenting of the CBD should always be kept in mind at the time of dissection to avoid injury and also try to memorize initial anatomy of the calot's triangle.
- A large distended gall bladder should be aspirated and lifted rather than grasped.
- Anterolateral traction is better than fundus pull to avoid tenting of the CBD
- Avoid meticulous dissection by energized instrument
- Better to do skeletonization through pledget
- During detachment of gall bladder from liver bed maintain plane of adipose tissue.
- Use suction irrigation frequently.

### Conflict of Interest

Nil.

### Grant Support

Nil.

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