A STUDY ON FACTORS FOR CONVERSION FROM LAPAROSCOPIC CHOLECYSTECTOMY TO OPEN CHOLECYSTECTOMY

Dissertation submitted to
The TamilNadu Dr.M.G.R. Medical University, Chennai.

With fulfillment of the regulations for the award of the degree of

MASTER OF SURGERY (GENERAL SURGERY)
Branch – II

DEPARTMENT OF GENERAL SURGERY
MADURAI MEDICAL COLLEGE
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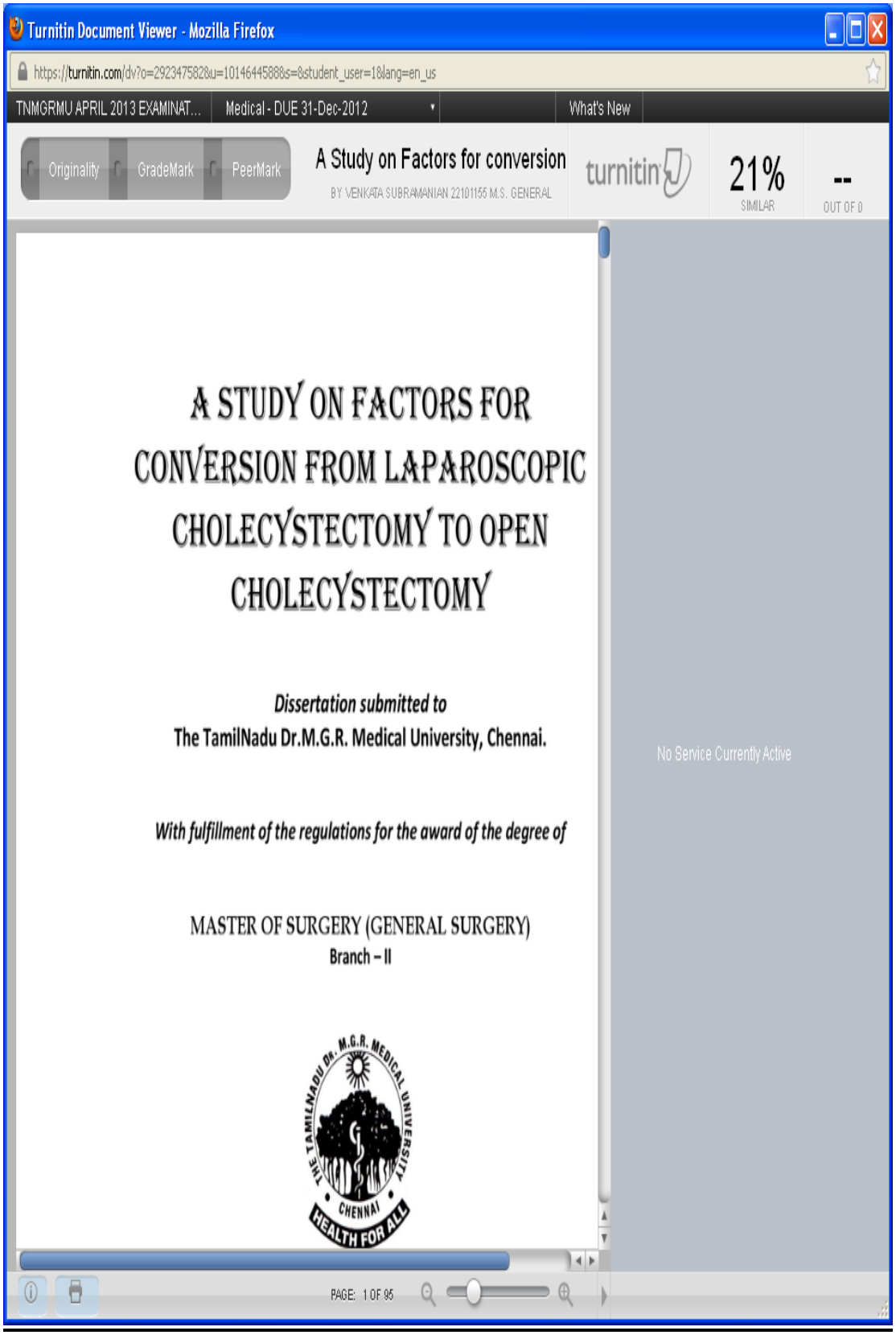
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CERTIFICATE BY THE GUIDE AND THE HEAD OF THE DEPARTMENT

This is to certify that the dissertation entitled "A study on factors for conversion from Laproscopic cholecystectomy to open cholecystectomy" submitted by Dr.A.VENKATA SUBRAMANIAN to the Tamil Nadu Dr. M.G.R. Medical University, Chennai in partial fulfillment of the requirement for the award of M.S Degree Branch – I (General Surgery) is a bonafide research work was carried out by him under direct supervision & guidance from October 2010 to September 2012 in the Department of General Surgery, Madurai Medical College.

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DECLARATION

I, **Dr.A.VENKATA SUBRAMANIAN** declare that, I carried out this work on, "**A Study on factors for conversion from laparoscopic Cholecystectomy to open Cholecystectomy**" at the Department of General Surgery, Madurai Medical College during the period of October 2010 to September 2012. I also declare that this bonafide work or a part of this work was not submitted by me or any others 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 regulations for the M.S. degree examination in General Surgery.

Dr.A.VENKATA SUBRAMANIAN

Place : Madurai

Date :24.12.2012.

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Dr.VENKATASUBRAMANIAN.A

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CONTENTS

INTRODUCTION

First performed in the year 1882 by Langenbuch, Open cholecystectomy has been the primary treatment of gallstone disease for most of the past century (Beal, 1984). The prevailing public perception of this operation as one that resulted in pain, disability, and a disfiguring scar engendered many attempts in the 1980s and 1990s at non-operative treatment of gallstones (Schoenfield & Lachin, 1981; Schoenfield et al, 1990).

Despite successful removal or dissolution of gallstones with some of these techniques, each is limited by the persistence of a diseased gallbladder. In 1985, Mühe in Böblingen, Germany, performed the first laparoscopically assisted cholecystectomy (Mühe, 1986). Even though facing early skepticism from the surgical community, laparoscopic cholecystectomy was accepted rapidly and recognized as the new "gold standard" for the treatment of gallstone disease. An NIH Consensus Development Conference in 1992stated that laparoscopic cholecystectomy "provides a safe and effective treatment for most patients with symptomatic gallstones. Indeed it appears to have become the procedure of choice."

The advantages of laparoscopic cholecystectomy over open cholecystectomy were earlier return of bowel function, decreased postoperative pain, improved cosmesis, shorter hospital stay, earlier return to activity, and decreased overall cost.

Surgeons should not hesitate to convert to open cholecystectomy if the anatomy is unclear, if complications arise, or if there is failure to make reasonable progress in a timely manner. It is “better to open one too many than to open one too few,” even if it means a longer hospital stay for the patient. Some complications requiring laparatomy are obvious, such as massive hemorrhage, bowel perforation, or major injury to the bile duct. Open laparatomy allows the additional tool of manual palpation and tactile sensation and should be performed when the anatomy cannot be delineated because of inflammation, adhesions, or anomalies. The demonstration of potentially resectable gallbladder carcinoma also dictates an open exploration. Finally, cases with CBD stones that cannot be removed laparoscopically and are unlikely to be extracted endoscopically should be converted to open operation without hesitation.

REVIEW OF LITERATURE

The Greek physician Trallianus described calculi within the hepatic radicles of a human liver. By the 16th century, Vesalius and Fallopius described gallstones found in the gallbladders of dissected human bodies. These observations lead to the recognition of cholelithiasis; however, pathogenesis and clinical significance of gallstones were seldom referred to. In the late 19th century, Langenbuch (1882) widened the understanding of gallstone pathology by performing the first cholecystectomy.

Cholecystitis, a common condition resulting from complications of cholelithiasis, occurs in two forms - acute or chronic. Acute cholecystitis requires urgent intervention, with antibiotics followed by cholecystectomy. In the setting of acute cholecystitis, cholecystectomy is optimally performed early after the diagnosis. If urgent cholecystectomy is not feasible, operation can be delayed until after the acute episode has resolved and then performed electively, provided that the acute process can be controlled and the symptoms resolve. Chronic cholecystitis is the manifestation of ongoing, intermittent inflammation with recurrent biliary colic. These patients benefit symptomatically from elective cholecystectomy. A less common version of cholecystitis is acute

acalculous cholecystitis, which occurs most often in critically ill patients. Although gallstones are, by definition, absent in this condition. But cholecystectomy specimens in these patients with acalculous cholecystitis often reveal biliary sludge.

ACUTE CHOLECYSTITIS

Pathogenesis

The cause of acute cholecystitis is an impacted gallstone either in the infundibulum or in the cystic duct. The impacted gallstone results in gallbladder distention leading to edema with acute inflammation. This can result in venous stasis and obstruction followed by thrombosis of the cystic artery and ischemia and necrosis of the gallbladder occur. The fundus of the gallbladder is the greatest distance from the cystic arterial blood supply so it is the sensitive to ischemia and is the most common site for necrosis of the gallbladder wall .The acute inflammation of cholecystitis may be complicated by secondary biliary infection. The most common of which are gram-negative bacteria of gastrointestinal origin, such as Klebsiella and Escherichia coli.

Clinical Manifestations:

Most patients with acute cholecystitis present with symptoms of severe, constant right upper quadrant or epigastric pain, sometimes with radiation to the subscapular area. This pain may be preceded by intermittent, self-limited episodes of biliary colic. Acute cholecystitis

also is often associated with fever and leukocytosis. Patients also may develop Murphy's sign, which is inspiratory arrest on palpation of the right upper quadrant. Other presenting symptoms include nausea, vomiting, and anorexia.

Diagnostic Evaluation and Imaging

Abdominal ultrasonography is a useful tool in patients with acute cholecystitis. Typical findings include gallstones, gallbladder wall thickening (>4 mm), and pericholecystic fluid in most patients. The sonographer can also access for pain and inspiratory arrest when the gallbladder is directly compressed by the ultrasound probe (sonographic Murphy's sign). Using conventional gray-scale imaging is used makes USG highly sensitive and specific for diagnosing acute cholecystitis, with an accuracy of greater than 90%. Other techniques of imaging that assess blood flow, such as color velocity imaging, may improve accuracy in some cases

Hepatobiliary scintigraphy is a useful study in patients when there is diagnostic uncertainty. This nuclear medicine study is performed with aminodiacetic acid derative (HIDA, PIPIDA, or DISIDA), that are taken up by hepatocytes and secreted in the bile. The tracer is labeled with technetium can visualize biliary function with scintigraphy. A normal scan delineates the biliary tree, with the gallbladder, and shows prompt emptying of the agent into the duodenum. Nonvisualization of the

gallbladder on hepato biliary scan is consistent with acute cholecystitis. Hepatobiliary scintigraphy is not useful in patients with poor hepatic function as it requires hepatic excretion of bile, but it is accurate in about 90% of patients. Hepatobiliary scintigraphy is more expensive, and requires a longer time than ultrasonography and it needs to be reserved for selected cases.

Computed tomography (CT) also can diagnose acute cholecystitis and provides detailed anatomic information than ultrasonography. CT is particularly useful in patients with complication such as pericholecystic abscess or an alternative diagnosis. The CT findings of acute cholecystitis are the same and include gall bladder wall thickening, pericholecystic stranding, distended gallbladder, high attenuation of bile and pericholecystic fluid. CT generally is less sensitive than ultrasonography for diagnosing acute cholecystitis particularly in the early in the course of inflammation

Treatment

Treatment with antibiotics against enteric bacteria should be started as soon as the patient is diagnosed with acute cholecystitis. The patient should be nil per oral, and intravenous resuscitation should be instituted in preparation for surgery. Parenteral analgesics can be given as needed.

The definitive treatment for acute cholecystitis is cholecystectomy. From the time this surgery was first performed in 1882 by Langenbuch,

open cholecystectomy is the standard of care for patients with acute cholecystitis. With laparoscopic cholecystectomy in the 1980s, the standard approach has changed such that now routinely performed laparoscopically. Benefits include a shorter postoperative stay and decreased morbidity.

Due to the increased morbidity and mortality, acute cholecystitis was considered to be a relative contraindication to laparoscopic cholecystectomy (Flowers et al, 1991). More recent reports have proved the improved safety of this technique in the acute setting (Chandler et al, 2000; Johansson et al, 2003; Lai et al, 1998; Lo et al, 1998). The conversion rate to an open procedure is higher with acute cholecystitis patients compared to patients undergoing elective operations for simple biliary colic (Schirmer et al, 1991), but most patients with acute cholecystitis can undergo laparoscopic cholecystectomy successfully. Retrospective series revealed that risk factors for conversion to open cholecystectomy include obesity (Rosen et al, 2002), elevated white blood cell count (Alponat et al, 1997; Kanaan et al, 2002), and male sex (Kanaan et al, 2002).

Other alternative surgical techniques have been proposed to treat patients with acute cholecystitis, including minilaparoscopic cholecystectomy (see Ch. 38), which uses 2- to 3-mm ports (Hsieh, 2003), and mini cholecystectomy (Assalia et al, 1997), in which a small

(mean 5.5 cm) incision is used to remove the gallbladder. These techniques, although innovative, do not have wide clinical applicability due to limited availability of instruments and specialist surgeons trained in their use. Laparoscopic cholecystectomy remains the standard therapy for definitive treatment of patients with acute cholecystitis and conversion to an open procedure if necessary.

In patients with a high perioperative risk, from sepsis or other underlying medical co morbidities, initial treatment of acute cholecystitis with percutaneous Cholecystostomy tube placement is preferred. These tubes can be placed using either ultrasound or CT guidance (Hatzidakis et al, 2002). This procedure effectively decompresses the gallbladder, evacuating the infected bile and relieving the pain associated with gallbladder distention, and is associated with a low complication rate (Byrne et al, 2003; Spira et al, 2002; Werbel et al, 1989). In addition, most patients (>80%) improve clinically within a short time (Byrne et al, 2003; Hatzidakis et al, 2002; Vauthey et al, 1993). After stabilization of the patient, delayed cholecystectomy should be performed, which often can be done laparoscopically (Spira et al, 2002). In high-risk patients in whom general anesthesia is contraindicated, percutaneous stone extraction has been used successfully (Gibney et al, 1987; Wong et al, 1999).

Timing of Surgery

The optimal interval of time between the diagnosis of acute cholecystitis and definitive treatment with cholecystectomy has been the subject of prospective randomized trials, nine evaluating open cholecystectomy and four evaluating laparoscopic cholecystectomy (Papi et al, 2004). The concern in operating on patients with early cholecystitis (typically defined as <3 days) is the potential for increased postoperative complications, including common bile duct injury. The risk of performing cholecystectomy late (weeks after the diagnosis of cholecystitis) is that some patients have recurrent symptoms during the period between diagnosis and surgical treatment, (Papi et al, 2004). In various randomized prospective trials evaluating the timing of open cholecystectomy, patients undergoing early operation experienced no increased perioperative morbidity or mortality and had a shorter length of hospital stay compared with patients undergoing delayed operation (Norrby et al, 1983; Van der Linden & Edlund, 1981). There was a difference in length of hospital stay, with patients undergoing delayed treatment requiring a more prolonged hospitalization (Papi et al, 2004). Even though it is safe to perform cholecystectomy either early or late after an episode of acute cholecystitis, patients benefit when surgery is performed early.

Performing laparoscopic cholecystectomy in patients with acute cholecystitis poses difficulty to surgeons because of the increased morbidity, including the feared complication of common bile duct injury. The acute inflammation may obscure the anatomy, leading to an increase in postoperative complications. Overall, there is no significant difference in postoperative morbidity or mortality, including common bile duct injury, when surgery is performed early. Additionally, there was no significant difference in the conversion rate to open cholecystectomy, though the conversion rate (20-30%) was clearly higher in patients with acute cholecystitis compared with patients undergoing elective laparoscopic cholecystectomy in the nonacute features.

CHRONIC CHOLECYSTITIS

Pathogenesis and Clinical Manifestations:

Chronic cholecystitis can result after one or more episodes of acute cholecystitis. It may evolve, without symptoms initially, just from the presence of gallstones. In most cases, patients describe one or more episodes of abdominal pain that is clinically consistent with biliary colic. Colic is a misnomer because the pain from chronic cholecystitis is usually constant in nature similar to that seen initially with acute cholecystitis, though it is self-limited and less severe. This pain seems to be because of intermittent obstruction of the gallbladder outflow.

There are well-described risk factors for the development of gallstones and subsequent chronic cholecystitis. Patients at particularly high risk include obese women, in whom pathologic changes of chronic inflammation are found even in the absence of gallstones (Calhoun &Willbanks, 1987; Csendes et al, 2003); this may be due to an increase in the cholesterol saturation of bile in obese patients and are often asymptomatic.

Diagnostic Imaging

Ultrasound examination of the gallbladder mostly reveals circumferential thickening of the gallbladder wall with cholelithiasis. In chronic cases, a small, shrunken gallbladder with a thickened wall and multiple gallstones is seen. Discomfort may be reproduced with direct pressure on the gallbladder with the ultrasound probe. Particularly in obese patients and patients with mild symptoms, the ultrasound examination shows no peculiar gallbladder wall abnormalities.

Treatment

Elective cholecystectomy is the treatment of choice for patients with symptoms of chronic cholecystitis. In most (≥90%) cases, cholecystectomy can be done laparoscopically. Patients occasionally comes with atypical pain (left hypochondrium), with minimal or no pain or with intermittent nausea or bloating. In these cases, evaluation for other causes of symptoms should be evaluvated, particularly if ultrasound shows gallstones, but no sequelae of chronic cholecystitis.

ACUTE ACALCULOUS CHOLECYSTITIS

Pathogenesis

Acalculous cholecystitis classically occurs in patients with coexisting major illnesses, such as sepsis, major trauma, or burns, or with major operations who are on parentral nutrition. If there is no stimulus of the gallbladder to contract, the bile becomes inspissated, and biliary sludge forms, pathology most likely involves some combination of ischemia, biliary stasis, and sepsis. Inspissated bile and sludge seem to play some causative role. This condition traditionally has also been described an increase in the de novo presentation of acalculous cholecystitis in the outpatient population, including patients with atherosclerotic vascular disease, such as seen in hypertension and diabetes (Parithivel et al, 1999; Ryu et al, 2003; Savoca et al, 1990).

Overall, acalculous cholecystitis represents about 5% to 15% of all cases of acute cholecystitis. There is a male predominance in cases of acalculous cholecystitis, in which most cases occur in women.

Increased risk of developing acalculous cholecystitis in this high-risk population: high Injury Severity Score, increased heart rate, and transfusion requirement at the time of admission and acutely injured patients, who require prolonged ventilatory and nutritional support, are at higher risk for the development of acalculous cholecystitis (Pelinka et al, 2003).

Diagnostic Evaluation and Imaging

Imaging algorithms for patients with suspected acalculous cholecystitis are similar for patients with acute cholecystitis. The initial imaging test is usually ultrasound, which typically reveals gallbladder distention, a thickened gallbladder wall, and biliary sludge without stones. Ultrasound is widely available, is easy to use even in acutely ill patients because it can be performed at the bedside, and is inexpensive. Ultrasound should be performed as the initial imaging modality for suspected acalculous cholecystitis.

Many critically ill patients may develop ultrasound abnormalities consistent with acalculous cholecystitis,but the combination of clinical symptoms and positive imaging findings is most likely to identify patients requiring surgical intervention.

Because of the difficulty in establishing a diagnosis in these critically ill patients, CT has been used as an additional imaging test. The advantage of CT is that imaging of the entire chest, abdomen, and pelvis can be obtained; this is particularly important in these patients, in whom the clinical signs and symptoms can be confusing, and multiple infectious causes may be found. CT may be more sensitive and specific than ultrasound, but has the disadvantage of requiring transport of the patient outside of the intensive care unit.

In patients in whom the diagnosis is questionable based on physical findings or ultrasound evaluation. Hepatobiliary scintigraphy can be used. The specificity of Hepatobiliary scintigraphy can be improved by administering morphine to cause constriction of the sphincter of Oddi and improve gallbladder filling.

Treatment

The definitive treatment for acalculous cholecystitis is cholecystectomy, which can be performed laparoscopically in most cases. In patients who are critically ill, placement of a percutaneous Cholecystostomy tube can be done. This allows decompression of the gallbladder and resolution of contained, infected bile and allows for the patient to recover from the acute illness before considering proceeding with cholecystectomy (McClain et al, 1997). Percutaneous Cholecystostomy may be definitive treatment for acalculous cholecystitis because there is no chronic obstruction of the gallbladder outlet as in acute cholecystitis (Davis et al, 1999; Vauthey et al, 1993)

COMPLICATIONS OF CHOLECYSTITIS

Gangrenous Cholecystitis

Gangrenous cholecystitis is more common in diabetic patients with acute cholecystitis who present with a leukocytosis (Fagan et al, 2003). The risk of gangrenous cholecystitis is higher in patients with acalculous cholecystitis, probably owing to the delay in diagnosis that commonly

occurs in this disease (Kalliafas et al, 1998; Swayne, 1986; Wang et al, 2003). The most common site for necrosis occurs in the fundus, which is most at risk for ischemia because it is furthest from the cystic arterial blood supply. Full-thickness necrosis is by definition always present in patients with gangrenous cholecystitis, but this condition may or may not result in free perforation of the gallbladder. In patients with free perforation, bile-stained abdominal fluid is present.

Because these patients are generally ill, imaging with CT scan is often performed. Findings most specific for acute gangrenous cholecystitis on CT scan include air in the wall or lumen, intraluminal membranes, an irregular wall, or pericholecystic abscess. And a contrast-enhanced CT scan may show a lack of mural enhancement in patients with gangrenous cholecystitis.

Empyema

By definition, the gallbladder contains purulent material in cases of gallbladder empyema. This condition usually is associated with acute cholecystitis with occurs in the setting of infected bile and an obstructed cystic duct. Most patients with empyema have calculous cholecystitis, but it also can occur in patients with acalculous disease (Tseng et al, 2000). The clinical course can mimic an intra-abdominal abscess from other causes, and with clinical manifestations of sepsis. These patients require urgent cholecystectomy or percutaneous Cholecystostomy tube

placement, depending on the severity of illness at the time of presentation (Tseng et al, 2000). Critically ill patients may be best served by a temporary Cholecystostomy tube followed by elective cholecystectomy.

Emphysematous Cholecystitis

Emphysematous cholecystitis is a result from the presence of gas-forming bacteria in the bile. Emphysematous cholecystitis may be seen in association with acute or gangrenous cholecystitis and is more common in men and diabetic patients. The diagnosis occasionally can be made by simple abdominal radiographs, but often diagnosed on ultrasound or CT scan (Bennett & Balthazar, 2003; Konno et al, 2002). Patients should receive intravenous antibiotics to include coverage for Clostridium species, followed by emergent cholecystectomy

Percutaneous Approaches to the Treatment of Gallbladder Disease

Image-guided interventional techniques have been developed to provide minimally invasive treatment of gallbladder disease. Percutaneous, image-guided Cholecystostomy is now an accepted method to decompress the acutely inflamed gallbladder if surgery is not indicated. Various methods aiming at elective, nonsurgical removal of gallbladder stones were introduced in the early 1990s, including extracorporeal shock wave lithotripsy (ESWL), contact dissolution of gallstones with methyl tetra-butyl ether (MTBE), and percutaneous mechanical cholecystolithotomy. Because these existing nonsurgical techniques of

gallstone removal cannot prevent recurrent gallstone formation, the indication to perform percutaneous gallstone removal without surgery is now very limited.

Percutaneous cholecystostomy for acute cholecystitis

Surgical cholecystostomy has long been used to provide external decompression Percutaneous cholecystostomy also has been employed to manage complications of cholecystitis like gallbladder perforation, empyema, or pericholecystic abscesses or as an alternative to percutaneous transhepatic drainage of the bile ducts in obstructive jaundice. More recently, percutaneous cholecystostomy has been used to provide access to the gallbladder for elective gallstone treatment along with stone dissolution techniques, percutaneous cholecystolithotomy.

The percutaneous access route to the gallbladder usually is done with ultrasound and based on the individual anatomic situation. Computed tomography (CT) can be used if ultrasound is not sufficient. Most authors favor the transhepatic approach to the gallbladder as a puncture through the attached portion of the gallbladder would reduce the risk of bile leakage into the peritoneal cavity . The acutely inflamed gallbladder is usually distended and just adjacent to the anterior abdominal wall, and the direct approach through the gallbladder fundus avoids the trauma to the liver that may be associated with percutaneous gallstone removal at a later date.

THE TECHNIQUE OF CHOLECYSTECTOMY

Open cholecystectomy increasingly is performed only in the few cases in which laparoscopic techniques fails. These cases can be recognized preoperatively or during laparoscopy.

The development of laparoscopic cholecystectomy has revolutionized the trend, initiated earlier in open surgical techniques, of removing the gallbladder through smaller incisions than previously (Dubois & Berthelot, 1982; Moss, 1986). Open cholecystectomy through a small incision has been compared with laparoscopic cholecystectomy and shown to give comparable results in terms of hospital stay and morbidity

Basically two techniques are used to perform cholecystectomy:

The retrograde technique, with initial dissection of the hilar structures of the gallbladder in Calot's triangle, and the anterograde or fundus down technique, in which the gallbladder is first separated from the liver before the cystic duct and artery are transected. Retrograde cholecystectomy was used in most cases until the advent of laparoscopic cholecystectomy, but the anterograde technique is gaining in importance because open cholecystectomy is now frequently necessary in surgically difficult situations. In addition, anterograde cholecystectomy has become routine for some authors using small incisions.

Indications

Cholecystectomy usually is performed for symptomatic cholelithiasis and for related complications. Cholecystectomy for acalculous cholecystitis, adenomyomatosis, or gallbladder carcinoma is less frequent. Asymptomatic cholelithiasis has been considered as an indication for cholecystectomy in diabetics or immune compromised patients, but this indication is controversial (Schweisinger& Diehl, 1996). There are two important areas in which improvement in diagnosis is necessary. First, patients with right upper quadrant abdominal pain may have symptoms unrelated to the presence of stones in the gallbladder. Post cholecystectomy pain, which has been observed in 30% of cases, may be the consequence of an operation performed for symptoms unrelated to the presence of gallstones (Bodvall & Overgaard, 1967). Second and by contrast, patients with characteristic symptoms but without stones in the gallbladder and who may be cured by a cholecystectomy have been identified (Lennard et al, 1984; Rhodes et al, 1988), and improvement in selection of cases for operation is necessary.

PREOPERATIVE ASSESSMENT

Some clinical features should alert the surgeon to possible operative difficulties. Repeated and prolonged attacks of biliary pain might be associated with chronic inflammation and dense adhesions or fibrous obliteration of Calot's triangle. Liver function tests should be performed systematically before cholecystectomy. Any abnormality (elevation of the serum bilirubin or alkaline phosphatase levels) requires serious attention because the change may not be caused by the presence of stones in the bile duct, but may be an index of other extrahepatic biliary tract disease. Diagnoses such as Mirizzi syndrome, tumor of the gallbladder or of the bile duct, choledochal cyst, and sclerosing cholangitis all are possibilities. Although patients submitted to cholecystectomy usually will have undergone ultrasonography, more detailed investigations should be performed if there is any doubt as to the integrity of the bile duct. Magnetic resonance imaging cholangiography and endoscopic retrograde cholangiography usually identify stones or other abnormalities.

Patients presenting with cirrhosis and portal hypertension also may have symptoms unrelated to the presence of stones in the gallbladder. Cholecystectomy in this context represents an increased risk of

hemorrhage (Bornman & Terblanche, 1985). Antibiotic prophylaxis is employed, with a single dose being given at the time of anesthetic premedication.

Preoperative assessment may orient the operation toward the laparoscopic or the open techniques. Apart from complicated cases in which intraoperative difficulties can be anticipated, a suspicion of tumor of the gallbladder is a contraindication for the laparoscopic approach except perhaps for staging purposes. Port site recurrences have been reported in many cases. In a survey of 10,925 laparoscopic cholecystectomies, gallbladder carcinoma was observed in 37 cases. The port site recurrence rate of 14% was independent of the stage of the tumor, but increased to 40% with intraoperative perforation of the gallbladder (Z'graggen et al, 1998). In another study, perforation of the gallbladder during laparoscopic cholecystectomy for cancer was observed in 44% of patients with early tumors, resulting in recurrent disease in 71% of them (Weiland et al, 2002). The results of these studies should not be used to condemn laparoscopic cholecystectomy for appropriate indications, but rather argue for more critical preoperative evaluation of imaging studies, which often have clear-cut but unappreciated signs of malignancy that would change the operative approach.

Operation

A perfect knowledge of the anatomy of the bile ducts and of the possible variations is necessary to perform safe cholecystectomy. Unidentified anatomic anomalies during operation often result in iatrogenic lesions of the bile duct. Precise intraoperative identification of the anatomy is necessary before dividing or ligating any structure.

Anatomy

The normal localization of the neck of the gallbladder and the cystic duct is between the peritoneal surfaces within the right anterior part of the hepatoduodenal ligament. The cystic artery runs transversely, forming with the cystic duct and bile duct the triangle described by Calot in 1891. The triangle of cholecystectomy (often misnamed as Calot's triangle) has for its upper limit not the cystic artery, but the inferior surface of the liver (Rocko et al, 1981). Dissection of this area should show the anatomic structures and allow safe dissection .

Triangle of cholecystectomy limited by the common hepatic duct, right hepatic duct, cystic duct, and liver.

A variety of abnormalities can alter the normal anatomy of the gallbladder. Bilobation and septa usually are not relevant. Duplication of the gallbladder is rare and might be associated with one or two cystic ducts. Agenesis is extremely rare, and the apparent absence of a gallbladder is most frequently related to an intrahepatic location; in such

cases, the infundibulum is usually extra hepatic. The gallbladder may be lying on the left side of a right-sided round ligament, being attached to the right lobe of the liver; in rarer instances, the gallbladder has been observed attached to the left lobe of the liver, on the left side of the round ligament (Fujita et al, 1998)

The junction between the cystic and common bile duct has many variations. The cystic duct may join the right side of the common bile duct after a parallel course, or it may be very short and almost nonexistent. An apparently short cystic duct might be a long duct fused and running parallel to the choledochus, or it may be connected to the right hepatic duct. The cystic duct also may join the left side of the choledochal, having crossed it anteriorly or posteriorly. The cystic duct occasionally may be contracted as a result of a chronic inflammatory process, such as seen in Mirizzi syndrome.

An unappreciated abnormal confluence of the hepatic ducts probably represents the most important source of error leading to damage tothe biliary tract during cholecystectomy. These variations may involve a direct hepatocystic ductal junction or a sectoral duct joining the choledochal just above or below the cystic duct. An abnormal confluence of the hepatic ducts has been reported in 43% of cases, and a low junction with a right sectoral duct has been reported in 20% of cases (Champetrier et al, 1989; Couinaud, 1957; Puente &Bannuva, 1983).

Abnormalities of the anatomy of the cystic artery also are frequent, and the right branch of the hepatic artery may be transected inadvertently if not identified. An origin of the right hepatic artery from the superior mesenteric artery results in passage of the vessel postero laterally to the common bile duct and behind the cystic duct where it may be vulnerable. Although the necessity to perform systematically intraoperative cholangiography has been controversial for decades (Talamini, 2003), surgeons have advocated the routine use of this procedure for many years. Besides showing unidentified stones or pathology in the intrahepatic or extrahepatic bile ducts, intraoperative cholangiography provides a precise view of the anatomy of the biliary ductal system. This view may help in avoiding operative errors resulting in severe biliary injury. In a review of 78 post cholecystectomy strictures, intraoperative cholangiography was performed in only 29% (Kelly & Blumgart, 1985). There is increasing evidence that performing systematically intraoperative cholangiography results in a lower incidence of iatrogenic bile duct injuries (Flum et al, 2003). Good technique is important.

Technique

Dissection must be performed close to the wall of the gallbladder, particularly in the region of the infundibulum and cystic duct. The cystic artery may be identified and safely ligated only when its relation with the gallbladder has been shown clearly. The retrograde technique, which

involves initial dissection of the hilar structures of the gallbladder and of the cholecystectomy triangle, should be chosen when there is clear visualization of its anatomic limits. Whenever the features in this region are not perfectly clear because of acute or chronic inflammation, the anterograde or fundus down technique is generally considered safer because initial dissection of the gallbladder from the fundus allows progressive demonstration of the anatomy down to the infundibulocystic junction. The basic principles of dissecting close to the gallbladder and showing clearly any structure before ligature or section is performed must be respected.

Incision

Different types of incisions may give access to the gallbladder. A right subcostal incision usually is done and provides direct and good access. A midline incision also provides good exposure. Transrectus incisions also have been used. The trend of minimally invasive surgery has resulted in the description of shorter incisions, which are justified only when access to perform a safe procedure is obtained, and when intra-operative assessment of the other intra-abdominal structures is unnecessary. In general, few details have been given on the technical aspects of mini laparotomy cholecystectomies . Ultrasound localization of the gallbladder may help to determine the site of incision (Assalia et al, 1997), the size of which may range from 2.5 to 10 cm, having also been

described as “minimum necessary” and “tailored to the individual patient” (Majeed et al, 1996). The incision may be a small right subcostal incision or a right transverse incision, with section of the rectus muscle, corresponding to a classic but smaller incision.

Alternatively, the small size of the incision may be exploited to reduce the trauma to the abdominal wall and the pain by muscle-sparing approaches. Two important elements have been taken into account in defining these incisions. First, it is important that the incision gives good access more to Calot's triangle (in the right paramedian region at the level of the 12th thoracic vertebra) than to the fundus of the gallbladder, which can be mobilized by traction into the operative field. Second, an incision in the “minimal stress triangle” should result in less operative pain because the abdominal wall is less subject to tension and movements at this level during ventilatory and other movements (Tyagi et al, 1994). The minimal stress triangle is located in the subxiphoid area. It has for its base a horizontal line joining the bilateral eighth chondrocostal cartilages and for vertex the xiphoid process. Calot's triangle lies within the boundaries of this triangle. The technique of microceliotomy described by Tyagi and colleagues (1994) uses this approach with a 3-cm transverse skin incision located on the right of the midline at the level of the baseline of the minimal stress triangle with corresponding vertical incision of the anterior and posterior rectus sheath 1 cm lateral to the linea alba for

approximately 5 cm in length extending inferiorly from the xiphoid process. This incision involves lateral retraction of the rectus muscle and incision of the peritoneum through the falciform ligament.

Pelissier (1990) described a 6-cm transverse incision in the epigastrium centered on the midline, 8 cm below the xiphoid process with transverse section of the linea alba extending slightly to the anterior sheath of both rectus muscles right and left; lateral retraction of the rectus muscles allowed limited incision of the posterior sheaths of both muscles. Section of the round ligament and retraction upward and downward give direct access to Calot's triangle. Clezy (1996) described a horizontal incision at the same level, but on the right side with incision of the anterior sheath of rectus muscle and, after simple medial retraction of the muscle, incision of the posterior sheath allowing access to Calot's triangle.

The advantages of performing a cholecystectomy through a minimal incision are controversial. Prospective randomized studies showed on the one hand no clear advantage of small incision cholecystectomy over conventional cholecystectomy for elective operations (Schmitz et al, 1997), but on the other hand less postoperative pain, shorter hospital stay, and earlier return to full activities for emergency cholecystectomy (Assalia et al, 1997).

Exposure of the Operative Field and Initial Assessment

The inferior aspect of the liver is normally accessible without dissection, but adhesions are often present and must be freed. Such adhesions may be dense and inflammatory, obscuring the anatomy of the region. Dissection should be performed close to the gallbladder, keeping in mind that a cholecystocolic or cholecystoduodenal fistula might be present. In this case, the fistula must be transected to expose the gallbladder. The opening in the colon or duodenum is subsequently sutured. If the gallbladder cannot be identified, one should suspect that it is scarred and contracted, or that it is located within the liver. It might be safe in such a situation to identify first the distal bile duct and dissect it from below until the infundibulum of the gallbladder or cystic duct is encountered. Intraoperative ultrasound examination may be useful.

Palpation of the intra-abdominal organs should be performed whenever possible, with special emphasis on the liver, hepatoduodenal ligament, and pancreas. The gallbladder must be palpated gently and not emptied by compression even if stones are not detected because their presence has already been shown by preoperative investigations, and manual compression of the gallbladder may result in migration of small stones into the common bile duct.

Placement of Retractors and Exposure

A retractor should be placed in the upper right part of the wound, whatever the form of the incision. The retractor can be held by an assistant, but it is usually better to have it fixed to the operating table because this not only spares a hand, but also provides steady, constant retraction. Another retractor is necessary to rotate the inferior aspect of the liver cephalad and expose the infrahepatic region. A right-angle or Deever retractor is usually held by an assistant, who must take care not to tear the liver capsule. Abdominal pads help to expose and isolate the operative field. The most important of these retractors is placed on the duodenum and transverse colon. A retractor, or the assistant's hand, by pulling downward, provides a gentle traction on the hepatoduodenal ligament. Two other abdominal pads may be placed medially and laterally to isolate the infrahepatic region.

Emptying of the Gallbladder

The dissection usually is eased by a slight distention of the gallbladder, and for this reason puncture of the gallbladder and aspiration of its contents should not be performed systematically. Gross distention may obscure the cholecystectomy triangle, however, and grasping of a distended gallbladder with a forceps might be impossible. One should not hesitate in these circumstances to puncture the fundus and aspirate bile; bile culture is indicated and is mandatory in cholecystitis or cholangitis.

When there is suspicion of gallbladder cancer, spillage of bile should be avoided. Spilled bile from a gallbladder containing malignant cells can result in spreading and implantation of tumor in the peritoneal cavity and conversion of a potentially curable disease into an incurable disease.

Retrograde Cholecystectomy

The peritoneum covering the hepatoduodenal ligament is incised anteriorly across the region of Hartmann's pouch; this incision is pursued posteriorly in the same way, giving easy access to the infundibulum of the gallbladder. A Duval or similar forceps is placed at the fundus of the gallbladder in the region of Hartmann's pouch, and dissection of the cholecystectomy triangle is started. It is important to keep close contact with the gallbladder and to show the junction between the gallbladder and the cystic duct. The lower limit of the triangle is the cystic duct, and a ligature is passed around it, but not tied. Slight tension produced by a clamphanging on this ligature might prevent migration of stones from the gallbladder into the cystic duct. The cystic artery is normally above the cystic duct; it is important to dissect it toward the gallbladder to see its final distribution into the gallbladder wall . This is the best way to prevent ligature of an aberrant right hepatic artery. At this stage, the junction of the gallbladder infundibulum with the cystic duct and the distribution of the cystic artery into the gallbladder wall are clearly visible. The cystic

duct is palpated to detect stones, which at this stage could be pushed back into the gallbladder. The cystic artery can be ligated and transected.

A ligature or a clamp is placed at the junction of the gallbladder and the cystic duct and the cystic duct may be divided. The gallbladder is dissected from its fossa by sharp dissection or diathermy, with the help of gentle traction or, occasionally, finger dissection. The dissection should be kept close to the gallbladder, within the cystic plate , to avoid damage to the liver parenchyma, which nevertheless may occur in cases of chronic cholecystitis. In cases of acute cholecystitis with considerable edema, this plane is best found by sharp dissection using scissors.

There occasionally may be small bile ducts connecting the gallbladder to the intrahepatic bile ducts. Transection of these ducts is without consequence when the biliary tree is not obstructed. Hemostasis of the gallbladder fossa does not pose any problem. If available, the argon beam coagulator is valuable. If the liver parenchyma has been lacerated, however, a gauze pack should be placed in the gallbladder bed and held in place with a retractor for at least 5 minutes. If the hemorrhage is not controlled, deep hemostatic sutures should be placed; care should be taken to ensure that such sutures do not entrap major branches of the right portal pedicle, which can lie in close proximity. Formal closure of the gallbladder bed is probably more harmful than useful in favoring postoperative local fluid collection.

The gallbladder should be opened and checked for the presence of tumors. Inspection of stone is also done. Usually only 50 ml of hemoserous fluid drains during the first 24 hours, after which the drain may be removed; however, the drain should be retained if there is excessive oozing or leakage of bile

Anterograde or Fundus Down Cholecystectomy

An incision of the gallbladder serosa is performed 0.5 cm from the liver edge, and a plane is developed between the serosa and the gallbladder wall by sharp dissection to allow entry to the cystic plate. The gallbladder is still vascularized via the cystic artery. In the region of the infundibulum, the cystic artery is seen to enter the gallbladder wall. After ligature and section of the cystic artery close to the gallbladder wall, the infundibulum is dissected free down to the junction with the cystic duct. This technique may cause migration of stones from the gallbladder into the cystic duct, but careful palpation could identify these stones after the cystic duct has been isolated. Not more than 0.5 to 1 cm of cystic duct should be dissected.

Cholecystectomy through Small Incisions

There is no fundamental difference between small incision cholecystectomy and the above-described techniques.

Partial Cholecystectomy

Cholecystectomy may be hazardous when only the fundus of the gallbladder can be recognized, and when the region of the infundibulum cannot be delineated because of fibrosis and inflammation obscuring the triangle of Calot. It is judicious to open the fundus and to introduce a finger into the gallbladder to guide the dissection. Impacted stones should be removed. If no bile appears, the cystic duct is probably occluded by fibrosis and inflammation. A partial cholecystectomy is the safest procedure in this situation. The anterior visible wall of the gallbladder is excised, but the posterior wall in contact with the liver is left in place down to the region of the infundibulum. The mucosa is removed by curettage and electrocoagulation, and a drain is placed in the region of the infundibulum. No attempt at ligating the cystic duct should be made when the region is severely altered by inflammation. If a gush of bile appears when a big impacted stone is removed from the infundibulum, a cholecystocholedochal fistula is probably present (Mirizzi syndrome type II). It is advisable to keep the opened distal part of the gallbladder intact to allow a cholecystoduodenostomy or a cholecystojejunostomy. Attempted direct repair of the fistula is unnecessary, difficult, and potentially hazardous .

Partial cholecystectomy also has been advocated in case of portal hypertension, for preventing severe bleeding during dissection. Bleeding from the transected wall of the remaining gallbladder is controlled by a running suture, and the orifice of the cystic duct is secured from within the gallbladder, using a purse-string or oversews technique. A hemorrhagic dissection in Calot's triangle is avoided (Bornman & Terblanche, 1985; Cottier et al, 1991).

INTRAOPERATIVE PROBLEMS

Intraoperative problems have been related to three main causes: dangerous surgery, dangerous anatomy, and dangerous pathology. Insufficient preoperative assessment of a complicated situation is another avoidable reason of intraoperative difficulties.

Dangerous surgery arises from inadequate or imprecise observation of the technical principles of cholecystectomy, insufficient experience, inadequate incision and exposure, or inadequate assistance (Andren-Sandberg et al, 1985; Smith, 1979). Some of the anatomic variations that have been mentioned previously are particularly dangerous; in particular, a narrow common bile duct can be mistaken for the cystic duct.

Dangerous pathology includes chronic or acute inflammation, which results in obscured anatomy and increased vascularity in the region of the cholecystectomy triangle. Portal hypertension is associated with increased venous collateralization, which makes the dissection

hemorrhagic and dangerous. Partial cholecystectomy has been advocated in both situations (Bornman&Terblanche, 1985; Cottier et al, 1991).

Hemorrhage in the cholecystectomy triangle represents potential danger because attempts at hemostasis by placing clamps with obstructed and insufficient view may result in inadvertent clamping of the right or common hepatic artery or of the bile duct. In this situation, one should first attempt to control the hemorrhage by digital compression or by clamping the hepatoduodenal ligament to localize its precise origin. Grasping the bleeding vessel should be done with precision so as to limit the risks of including another structure in the ligature. Cholangiography, even if already performed, may be repeated and analyzed carefully after hemostasis because it may reveal an iatrogenic lesion of the bile duct (leak, incomplete or complete occlusion).

First performed in 1882 by Langenbuch, open cholecystectomy has been the primary treatment of gallstone disease for most of the past century (Beal, 1984). The prevailing public perception of this operation as one that resulted in pain, disability, and a disfiguring scar engendered many attempts in the 1980s and 1990s at nonoperative treatment of gallstones (Schoenfield&Lachin, 1981; Schoenfield et al, 1990). Despite successful removal or dissolution of gallstones with some of these techniques, each is limited by the persistence of a diseased gallbladder. In 1985, Mühe in Böblingen, Germany, performed the first laparoscopically

assisted cholecystectomy (Mühe, 1986).Eventhough meeting early skepticism from the surgical community, laparoscopic cholecystectomy was accepted rapidly and recognized as the new "gold standard" for the treatment of gallstone disease. An NIH Consensus Development Conference in 1992 stated that laparoscopic cholecystectomy "provides a safe and effective treatment for most patients with symptomatic gallstones. Indeed it appears to have become the procedure of choice."

The advantages of laparoscopic cholecystectomy over open cholecystectomy were earlier return of bowel function, decreased postoperative pain, improved cosmesis, shorter hospital stay, earlier return to activity, and decreased overall cost. Laparoscopy (from the Greek laparo, "the flank," and skopein, "to examine") was first performed in 1901 by Kelling in Dresden, German. He used room air filtered through sterile cotton for pneumoperitoneum and a Nitzecystoscope to view the abdominal cavity of a dog. Kelling named the procedure as Kölioskopie and published this in Münchener Medizinische Wochensch rift in January 1902. As a correlate to current health care motivations, Kelling later reported that his use of the laparoscope had escalated rapidly in the postwar period secondary to the sparse economic resources in Germany. His reasons were basic - smaller incisions, more rapid recovery, and shorter and less costly hospital stays (Kelling, 1923; Underwood, 1997). In the same publication, Jacobeus (1911) in

Stockholm, reported the first clinical application of laparoscopy and thoracoscopy, explaining the laparoscopic diagnosis of intra-abdominal tuberculosis, cirrhosis, syphilis, and malignancy. Over the next 2 decades, various gases were used to insufflate the abdomen and create a working space. Zollikofer, in Switzerland, in 1924 recommended the use of carbon dioxide for pneumoperitoneum. Advantages opposed to room air, carbon dioxide inhibits combustion and is rapidly absorbed postoperatively by the peritoneum. The primary mode for insufflations is the Veress needle, which was introduced by Veress in Hungary in 1938. This device incorporates a spring-loaded blunt obturator at its tip, that protects the internal viscera from the sharp needle tip when it has penetrated the fascia and peritoneum.

In 1985, the first laparoscopically assisted cholecystectomy was performed by Mühe in Böblingen, Germany. Themain think that brought laparoscopy into the mainstream of general surgery was the advent in 1985 of the miniature video camera. Attaching a video camera to the laparoscope's eyepiece lead all members of the operating team to view the operative field same time and from the same view. In 1987, Mouret, a French surgeon, Lyon, performed the first video-laparoscopic cholecystectomy. In 1988, this new technique was introduced in the United States. During this period 1989-1991, it is estimated that approximately 20,000 American general surgeons received training in

laparoscopic techniques. Laparoscopic cholecystectomy was quickly accepted as the new “gold standard”. The resurgence of interest in the laparoscope initiated by laparoscopic cholecystectomy has led to near-revolutionary change in general surgery and the exponential development of newer procedures, such as laparoscopic antireflux procedures, appendectomy, adrenalectomy, inguinal herniorrhaphy, colon resection, and various intrathoracicvideoscopic procedures.

INDICATIONS

The indications for cholecystectomy, the same as the indications for open cholecystectomy. Biliary colic is a severe and episodic right upper abdominal or epigastric pain, mostly radiating to the back. Attacks frequently occur postprandially, awaken the patient from sleep. Patients with asymptomatic gallstones have about 20% chance of developing symptoms, so the risks associated with “prophylactic” operation outweigh the potential benefit of surgery in most patients. Prophylactic laparoscopic cholecystectomy for asymptomatic cholelithiasis may be justified for certain patients.

Indications for Laparoscopic Cholecystectomy

- Symptomatic cholelithiasis
- Biliary colic
- Acute cholecystitis

Asymptomatic cholelithiasis

- Sickle cell disease
- Total parenteral nutrition
- Chronic immunosuppression
- No immediate access to health care facilities (e.g., missionaries, military personnel, Peace Corps workers, relief workers)
- Incidental cholecystectomy for patients undergoing laparoscopic procedure for other indications
- Acalculouscholecystitis (biliary dyskinesia)
- Gallstone pancreatitis
- Gallbladder polyps >1 cm in diameter
- Porcelain gallbladder

Disadvantages of laparoscopic cholecystectomy

Patients must be acceptable candidates for general anesthesia and possible laparotomy. The limited two-dimensional monocular image of the videoscope, and the operative field of view often is directed byan individual other than the surgeon. It is more difficult controlling

significant hemorrhage using laparoscopic technology than open surgical field. There also is less tactile discrimination of structures using laparoscopic instruments as opposed to direct digital palpation .

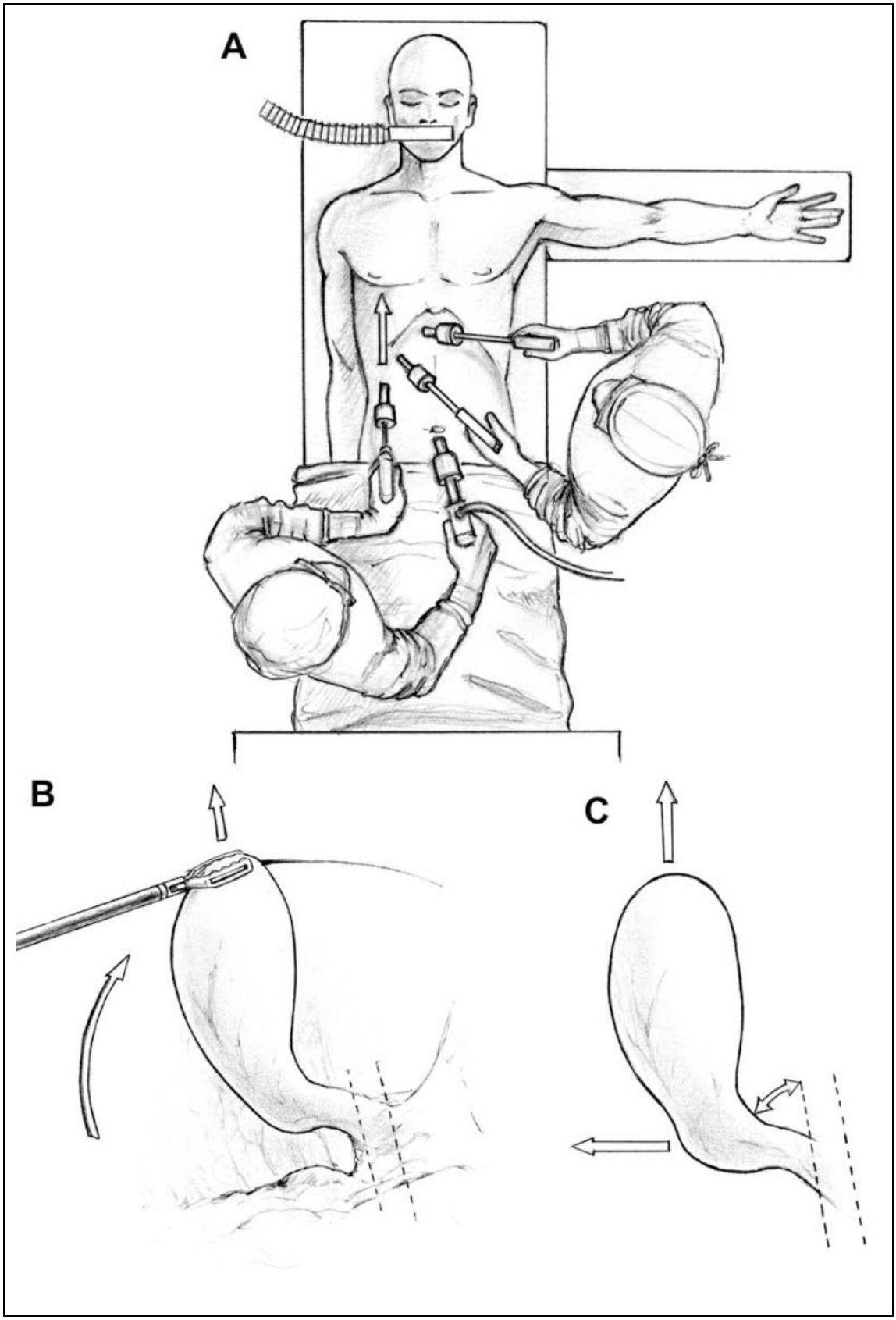
Carbon dioxide insufflation to create the pneumoperitoneum is associated with various potential risks, including reduction of vena caval flow and systemic hypercarbia with acidosis.

Finally, the videoscopic technology and minimal access instrumentation are costly, complex, and continually evolving requiring the presence of appropriately trained personnel.

INSTRUMENTATION

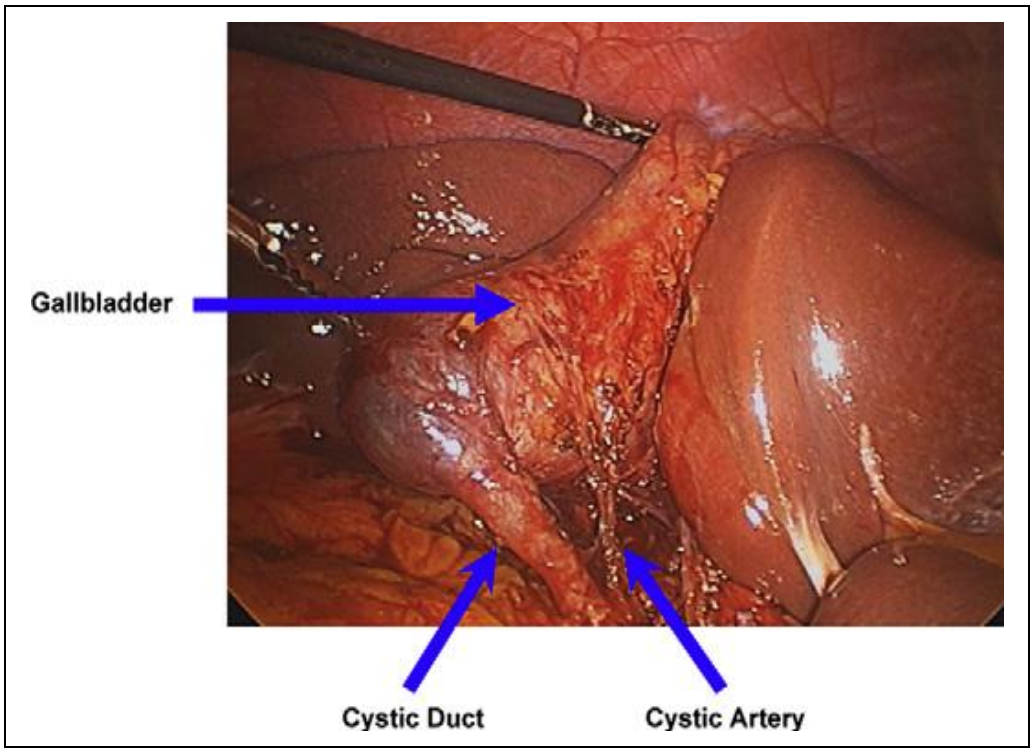
Operating Room Setup

Using the “American” technique, the surgeon stands to the left of the patient, the first assistant stands to the patient's right, and the laparoscopic video 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 always must maintain the proper orientation of the camera and keep the operating instruments in the center of the video image. Following all instruments as they come into or exit from the operative field is a matter of surgeon preference. Sharp instruments should never be moved intracorporeally unless they are under direct videoscopic vision.


A
B
C

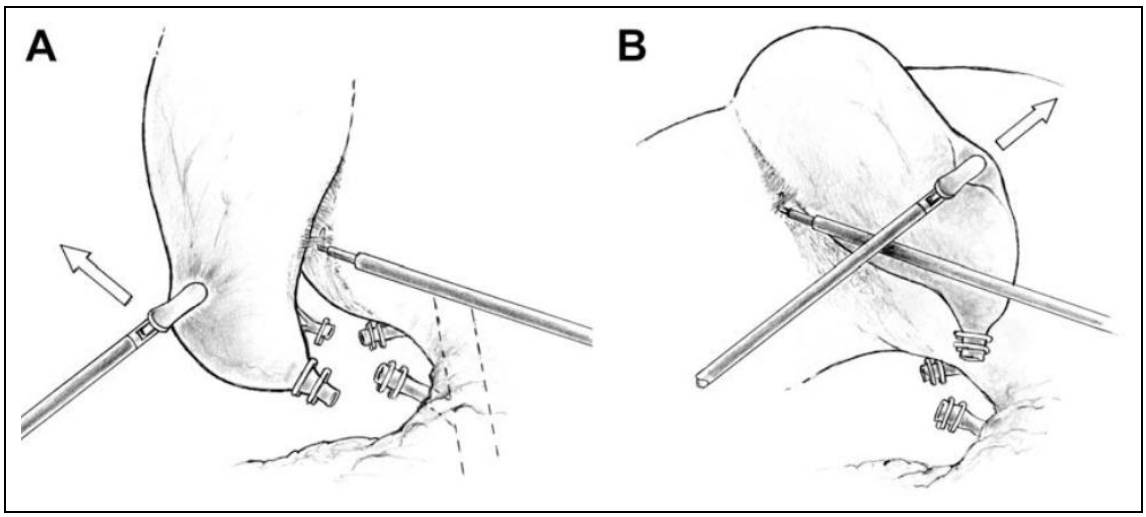
The patient is placed supine on the operating table with the surgeon standing at the patient's left side. Some surgeons prefer to stand between the patient's legs while doing laparoscopic procedures in the upper abdomen. The pneumoperitoneum is created with carbon dioxide gas, either with an open technique or by closed needle technique. Initially, a small incision is made in the upper edge of the umbilicus. With the closed technique, a special hollow insufflation needle (Veress needle) that is spring-loaded with a retractable cutting outer sheath is inserted into the peritoneal cavity and used for insufflation. Once an adequate pneumoperitoneum is established, a 10-mm trocar is inserted through the supraumbilical incision. With the open technique, the supraumbilical incision is carried through the fascia and into the peritoneal cavity. A special blunt cannula (Hasson cannula) is inserted into the peritoneal cavity and anchored to the fascia. The laparoscope with the attached video camera is passed through the umbilical port and the abdomen inspected. Three additional ports are placed under direct vision (Fig. 32-18). A 10-mm port is placed in the epigastrium, a 5-mm port in the middle of the clavicular line, and a 5-mm port in the right flank, in line with the gallbladder fundus. Occasionally, a fifth port is required for better visualization in patients recovering from pancreatitis or those with semi-acute cholecystitis, as well as in very obese patients.

Through the lateralmost port, a grasper is used to grasp the gallbladder fundus. It is retracted over the liver edge upward and toward the patient's right shoulder to expose the proximal gallbladder and the hilar area. Exposure of the hilar area may be facilitated by placing the patient in reverse Trendelenburg position with slight tilting of the table to bring the right side up. Through the midclavicular port a second grasper is used to grasp the gallbladder infundibulum and retract it laterally to expose the triangle of Calot. Before this, it may be necessary to take down any adhesions between the omentum, duodenum, or colon, and the gallbladder. Most of the dissection is carried out through the epigastric port using a dissector, hook cautery, or scissors.



<u>The critical view of safety is obtained when the lateral and medial aspects of the gallbladder (horizontal arrow) have been dissected free, and only 2 structures are seen entering the gallbladder; the cystic artery and the cystic duct (slanted arrows).</u>

The dissection starts at the junction of the gallbladder and the cystic duct. A helpful anatomic landmark is the cystic artery lymph node. The peritoneum, fat, and loose areolar tissue around the gallbladder and the cystic duct–gallbladder junction is dissected off toward the bile duct. This is continued until the gallbladder neck and the proximal cystic duct are clearly identified. The next step is the identification of the cystic artery, which usually runs parallel to and some what behind the cystic duct. A hemoclip is placed on the proximal cystic duct. If an intraoperative cholangiogram is to be performed, a small incision is made on the anterior surface of the cystic duct, just proximal to the clip, and a cholangiogram catheter is passed into the cystic duct. Once the cholangiogram is completed, the catheter is removed and two clips are placed proximal to the incision, and cystic duct is divided. A wide cystic duct may be too big for clips, requiring placement of a pre-tied loop ligature to close. The cystic artery is then clipped and divided.



To–and-fro retraction for dissection off liver bed. (A) Traction vector to divide medialattachments. (B) Traction vector for lateral attachments.

Finally, the gallbladder is dissected out of the gallbladder fossa, using either a hook or scissors with electrocautery. Before the gallbladder is removed from the liver edge, the operative field is carefully searched for bleeding points and the placement of the clips on the cystic duct and cystic artery is inspected. The gallbladder is removed through the umbilical incision. The fascial defect and skin incision may need to be enlarged if the stones are large. If the gallbladder is acutely inflamed or gangrenous, or if the gallbladder is perforated, it is placed in a retrieval bag before it is removed from the abdomen. Any bile or blood that has accumulated during the procedure is sucked away, and if stones were spilled, they are retrieved, placed inside a retrieval bag, and removed. If the gallbladder was severely inflamed, gangrenous, or if any bile or blood is expected to accumulate, a closed suction drain can be placed through one of the 5-mm ports and left underneath the right liver lobe close to the gallbladder fossa.

The fascia of the umbilical incision is closed with one or two large absorbable sutures. Closure of the subxiphoid fascia is optional because visceral herniation is unlikely to occur owing to the oblique entry angle of the trocar into the abdominal cavity and its location anterior to the falciform ligament. The skin of the subxiphoid and umbilical incisions is closed with subcuticular absorbable sutures. The skin incisions at both 5-

mm port sites can be closed with adhesive strips or skin closure adhesives. The orogastric tube is removed in the operating room, and the patient is transferred to the postanesthesia care unital to prevent bile duct injury during laparoscopic cholecystectomy

SPECIAL CONSIDERATIONS

Conversion to Open Operation

Surgeons performing laparoscopic cholecystectomy should not think of conversion to open operation as a complication, but rather mature judgment, and should not hesitate to convert to a traditional open cholecystectomy if the anatomy is unclear, if complications arise, or if there is failure to make reasonable progress in a timely manner. It is "better to open one too many than to open one too few," even if it means a longer hospital stay for the patient. Some complications requiring laparotomy are obvious, such as massive hemorrhage, bowel perforation, or major injury to the bile duct. Open laparotomy allows the additional tool of manual palpation and tactile sensation and should be performed when the anatomy cannot be delineated because of inflammation, adhesions, or anomalies. The demonstration of potentially resectable gallbladder carcinoma also dictates an open exploration. Finally, cases with CBD stones that cannot be removed laparoscopically and are

unlikely to be extracted endoscopically should be converted to open operation without hesitation.

When to Convert from Open to Laparoscopic Cholecystectomy

- Injury to major blood vessels, viscus, or bile duct
- Anatomy unclear
- Failure to progress in a timely fashion
- Pathology not amenable to minimal access surgical techniques
- Choledocholithiasis untreatable by minimal access surgical techniques or postoperative endoscopic techniques
- Billroth II
- Previous failed ERCP
- Minimal endoscopic experience

Acute Cholecystitis

Cholecystectomy is the definitive treatment for patients with acute cholecystitis. Early cholecystectomy performed within 2 to 3 days of presentation is preferred over interval or delayed cholecystectomy that is performed 6 to 10 weeks after initial medical therapy.About 20% of patients fail initial medical therapy and require surgery during the initial admission or before the end of the planned cooling-off period.

Laparoscopic cholecystectomy is the preferred approach to patients with acute cholecystitis. Conversion to an open procedure should be made if the inflammation prevents adequate visualization of important structures. The conversion rate to an open cholecystectomy is higher (4%-35%) in the setting of acute cholecystitis than with chronic cholecystitis. Numerous studies have shown the morbidity rate, hospital stay, and time to return to work are lower in patients undergoing laparoscopic cholecystectomy than open cholecystectomy. Early laparoscopic cholecystectomy, due to a reduced length of hospital stay and readmissions, is a more cost-effective approach than open cholecystectomy for acute cholecystitis. Patients who are operated on early in the course of their illness (within 48 hours) are more likely to have their procedure completed laparoscopically (4% versus 23%) than patients with a longer duration of symptoms. Additional factors predicting the need to convert to an open cholecystectomy include increased patient age, male gender, elevated American Society of Anesthesiologists class, obesity, and thickened gallbladder wall (>4 mm).

Acute cholecystitis may progress to empyema of the gallbladder, emphysematous cholecystitis, or perforation of the gallbladder despite antibiotic therapy. In each case, emergency cholecystectomy is indicated, if the patient can safely withstand an anesthetic. In most patients, cholecystectomy can be performed and is the best treatment of

complicated acute cholecystitis. Occasionally, the inflammatory process obscures the structures in the triangle of Calot, precluding safe dissection and ligation of the cystic duct. In these patients, partial cholecystectomy, cauterization of the remaining gallbladder mucosa, and drainage avoid injury to the common bile duct. In patients considered too unstable to tolerate a laparotomy, percutaneous transhepatic cholecystostomy under local anesthesia can be performed to drain the gallbladder. This procedure leaves the gallbladder in place, which may be a source of ongoing sepsis. Drainage and IV antibiotics, followed by interval laparoscopic cholecystectomy, can then be performed after 3 to 4 months to allow the patient to recover and the acute inflammation to resolve.

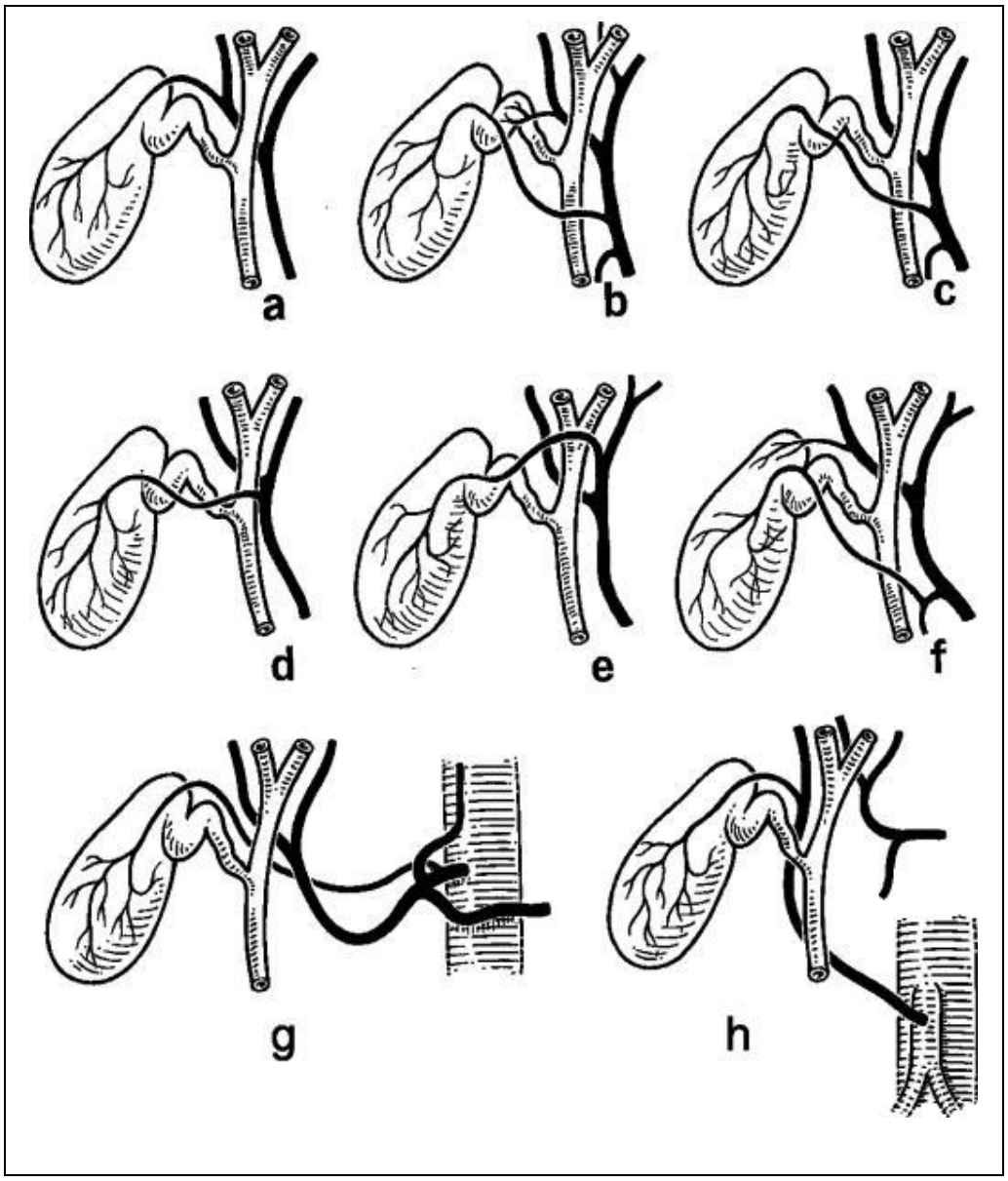
Intraoperative Gallbladder Perforation

Perforation of the gallbladder with bile or stone leakage can be a nuisance, but should not ordinarily require conversion to open cholecystectomy. Perforation may occur secondary to traction applied by the grasping forceps or electrosurgical thermal injury during removal of the gallbladder from its bed. In our experience, almost one third of the patients have had intraoperative spillage of bile or stones (Jones et al, 1995). Patients with a bile leak have not experienced an increased incidence of infection, prolongation of hospitalization or postoperative disability, or adverse long-term complications (mean follow-up of 41 months in 250 consecutive laparoscopic cholecystectomy patients). The

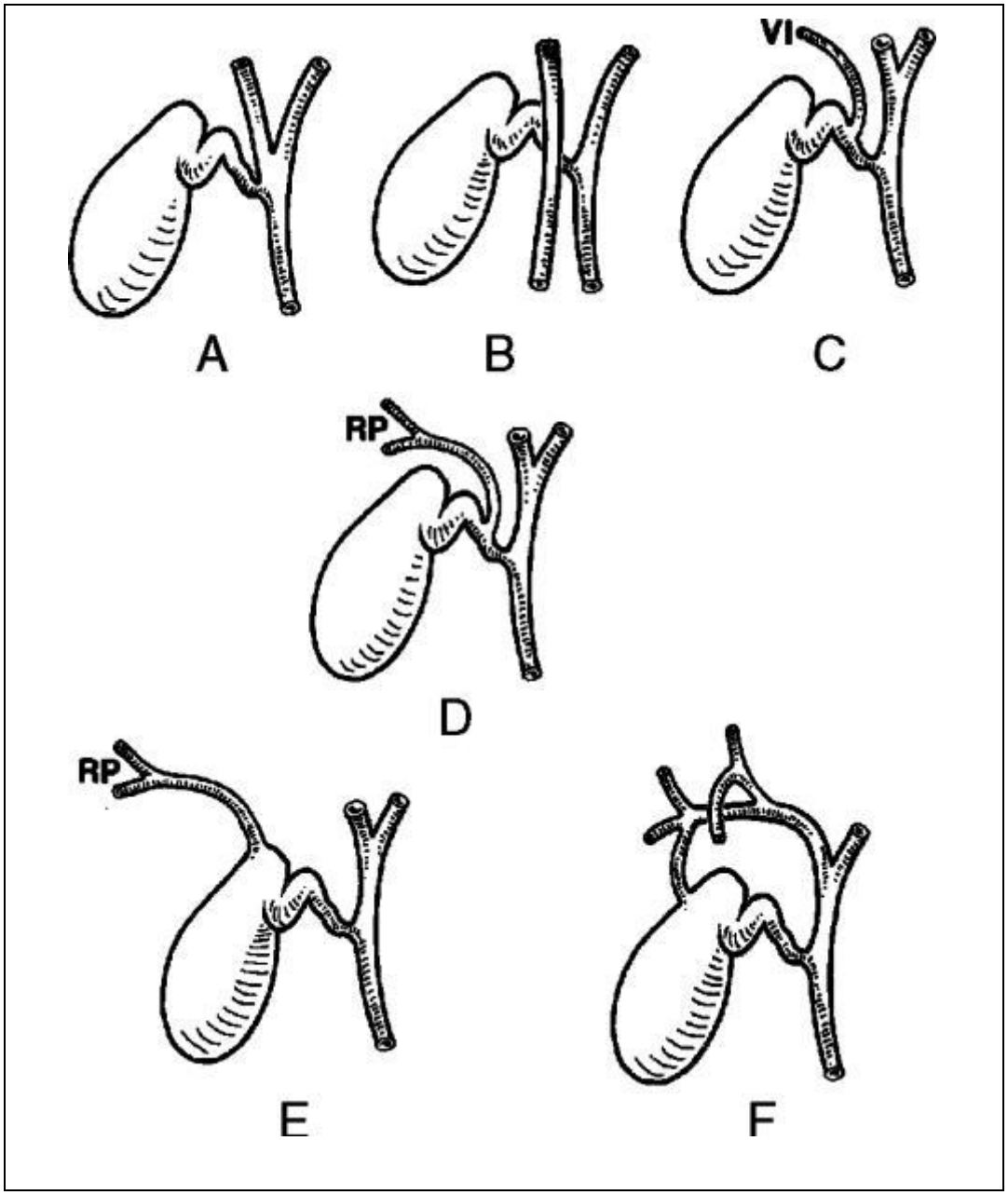
only difference between patients with and without bile leakage was that the operating time of patients with a gallbladder perforation was approximately 10 minutes longer, presumably owing to the time spent cleaning up the operative field. When perforation does occur, the bile should be aspirated completely, and irrigation should be used liberally. The hole in the gallbladder is best secured with a grasping instrument and sutured or tied with an endoloop. The stones should be retrieved and removed. Gallbladder spillage, when treated in this manner, results in no adverse short-term or long-term complications. Escaped stones composed primarily of cholesterol pose little threat of infection. Pigment stones frequently harbor viable bacteria, however, and potentially may lead to subsequent infectious complications if allowed to remain in the peritoneal cavity (Deziel et al, 1993). The long-term complications of retained stones, either intra-abdominally with resultant abscess formation or intramurally with resultant port site abscess, have not been prospectively studied, but case reports and case series in the surgical literature document a clear potential for long-term infectious complications (Carlin et al, 1995; Horton & Florence, 1998; Parra-Davila et al, 1998; Shocket, 1995; Zamir et al, 1999). The relative infrequency of these complications probably does not justify conversion to open operation in the face of spilled stones, but vigilance in avoidance of perforation, a careful search for escaped stones, and liberal use of a plastic retrieval bag for large and friable gallbladders are recommended (Zamir et al, 1999).

Anatomic Variations

One of the frequent anomalies is a right hepatic artery that loops up onto the infundibulum of the gallbladder. This anomaly may be misidentified as the cystic artery, leading to injury to the hepatic artery. The surgeon occasionally notices only a small cystic artery on the medial aspect of the gallbladder; when this occurs, one should be alert for a posteriorbranch leading onto the dorsal aspect of the gallbladder. If great care is not taken, brisk hemorrhage can occur.



A short cystic duct is seen frequently and may be draining into the right hepatic duct or a low-entry right sectoral hepatic duct (2%) or common hepatic duct (1%) or connect the infundibulum with the CBD by a duct of only a few millimeters in length in 5 % to 6% of cases (Berci, 1992; Reid et al, 1986). During open cholecystectomy, this is comparatively easy to recognize, that too cholecystectomy is performed in a fundus first fashion. During laparoscopic cholecystectomy, these ducts are in danger of being mistaken for a normal cystic duct and divided. The most dangerous variant is when the cystic duct joins a low-lying aberrant right sectoral duct. These injuries are underreported because occlusion of an aberrant duct may be asymptomatic and even unrecognized. In addition to anomalous biliary ducts, one may have accessory ducts draining into the cystic duct or from the liver directly into the gallbladder (ducts of Luschka). Since the widespread use of laparoscopic cholecystectomy, there has been an increased occurrence of bile leaks from so-called ducts of Luschka. It is likely that many of these bile leaks are due to dissection into the liver substance with injury to a normal, albeit superficial, intrahepatic biliary radicle.



If the liver is enlarged and heavy as a result of fatty infiltration or cirrhosis, it may be difficult, if not impossible, to expose the hepatocystic triangle. In cirrhosis, the firm enlarged liver is not only difficult to lift, but also has a propensity to bleed when retracted. If there is associated portal hypertension, bleeding from small veins in the gallbladder bed,

adherent omentum, or even trocar entry sites can make laparoscopic cholecystectomy extremely difficult and dangerous

COMPLICATIONS

Many complications related to laparoscopic removal of the gallbladder are similar to the complications that occur during traditional open cholecystectomy and include hemorrhage, bile ductinjuries, bile leaks, retained stones, pancreatitis, wound infections, and incisional hernias. Other potential complications are pneumoperitoneum related (gas embolism, vagal reaction, ventricular arrhythmias, or hypercarbia with acidosis) and trocar related (injuries to the abdominal wall, intra-abdominal organ, or major blood vessels). The "protective" shield on disposable trocars is not a guarantee against perforation of intestine or major vessels, especially after previous abdominal operations. Regardless of the make of trocar, during its insertion one should never aim toward the spine or the location of the great vessels, and a hand is used as a "brake" to prevent inadvertently introducing the trocar too far. Insertion of the initial trocar, especially when performed in a closed fashion, can cause iatrogenic injury to the bowel, bladder, great vessels. When a trocar injury to a major blood vessel is suspected, the patient must be opened immediately without removing the trocar until the involved blood vessel is isolated. In contrast, if the small-bore Veress needle enters a viscus or blood vessel, the operation generally can be completed and the patient

monitored closely for signs of complications in the postoperative period. The trocars can lacerate blood vessels in the abdominal wall.so before removal, trocar should be visualized from the peritoneal aspect using the laparoscope. If significant hemorrhage is seen, it usually can be controlled with cautery, intraoperative tamponade with a Foley catheter, or a through-and-through suture on each side of the trocar insertion site. Most complications occur early in the surgeon's experience. In a multivariate regression analysis of 8839 laparoscopic cholecystectomies in which there were 15 bile duct injuries, the only significant factor associated with an adverse outcome was the surgeon's experience with the procedure (Moore & Bennett, 1995). The regression model predicted that a surgeon had a 1.7% chance of a bile duct injury occurring in the first case and 0.17% chance of a bile duct injury in the 50th case.

Complications of Laparoscopic Cholecystectomy

- Hemorrhage
- Bile duct injury
- Bile leak
- Retained stones
- Pancreatitis
- Wound infection
- Incisional hernia

- Pneumoperitoneum related
- Carbon dioxide embolism
- Vasovagal reflex
- Cardiac arrhythmias
- Hypercarbic acidosis
- Trocar related
- Abdominal wall bleeding, hematoma
- Visceral injury
- Vascular injury

Of all the potential complications, biliary injuries have received the most attention and are discussed at length elsewhere in this text . These injuries can cause major morbidity, prolonged hospitalization , high costs, and litigation . In addition to the surgeon's experience and aberrant anatomy, many reports mention chronic inflammation with dense scarring, operative bleeding obscuring the field, or fat in the portal area contributing to the biliary injuries classic biliary injury occurs, however, when the CBD or a right hepatic duct is mistaken for the cystic duct and is divided between clips. Many surgeons attribute this misidentification to the direction of traction of the gallbladder pulling the CBD and the cystic duct into alignment, making them appear to be one. Other contributing factors to misidentification are a short cystic duct, a large stone in

Hartmann's pouch (making retraction and display of the cystic duct difficult), or tethering of the infundibulum to the CBD by acute or chronic inflammation. Constant awareness of these potential misidentifications and technical causes of biliary injuries is the best method of prevention. If a bile duct injury occurs, an immediate repair should be performed. When a bile duct injury is discovered in the postoperative period, a coordinated effort by radiologists, endoscopists, and surgeons is necessary to optimize management . There should be no hesitation in asking for the help of a surgeon experienced in biliary repair.

AIMS AND OBJECTIVES OF THE STUDY

1. To study the factors that lead to conversion from Laparoscopic cholecystectomy to open method inregard toage, sex, clinical presentation, laboratory values, Ultrasonogram and Operative findings.
2. To assess preoperative factors that might predict the chances of conversion
3. To assess the intra operative reason that results to conversion.

MATERIALS AND METHODS

STUDY AREA

This study was conducted in the Department of General surgery and Department of Surgical Gastroenterology in Madurai Medical College and Government Rajaji Hospital, Madurai from October 2010 to September 2012 for a period of two years.

METHODOLOGY

This is a retrospective study done in the Madurai Medical College and Government Rajaji Hospital. The details of all the patients who underwent and attempted Laparoscopic cholecystectomy in the Department of General surgery and Department of Surgical Gastroenterology in Madurai Medical College and Government Rajaji Hospital, Madurai were collected from the Medical Records Department and entered in the proforma. (Annexure2). The details collected were collected from the case sheets and entered into the proforma :

1. Age
2. Sex
3. Clinical History
4. Physical Examination findings

5. Laboratory findings
6. Ultrasound findings
7. Procedure performed
8. Intraoperative findings
9. Reason for conversion
10. Other treatments.

INCLUSION CRITERIA

Cases above age 15 years of age diagnosed as cholelithiasis /cholecystitis treated surgically by laparoscopic approach for cholecystectomy and in whom the laparoscopic procedure was abandoned and open conventional cholecystectomy resorted to for any intra operative reason.

EXCLUSION CRITERIA

1. Patients below 15 years of age.
2. Patients who were diagnosed as having choledocholithiasis preoperatively with or without biliary obstruction.
3. Patients who underwent a planned open cholecystectomy.

SAMPLE SIZE

1. Total No. of patients who were posted for laparoscopicmethod
2. No of patients converted to open cholecystectomy (study group)

Operative technique

Standard four-trocar Laparoscopic cholecystectomy procedure was performed. Adhesions were released by blunt, sharp and hydro dissection and by use of suctioncannula and gauze piece. Distended GBs were decompressed by suction and aspiration. Cystic Duct and Cystic artery were identified, ligated and divided with endoclips. Wide Cystic Ducts if found, were suture ligated and divided. Fundus first method and sub total cholecystectomies were performed it Calot's triangle anatomy is not clear. Gallbladder was dissected from GB fossa by use of hook/spatula/scissors. Hemostasis was done by using monopolar cautery. GB was extracted through epigastric port. GB fossa re-examined and suction dried. Drains were kept through 5 mm port at the anterior axillary line. Port closure was used for port site bleeding. Skin closure was done with skin stapler or suture.

When conversion was required either a Kocher's incision or an upper midline incision was made. Decision for conversion was based on surgeon clinical judgment.

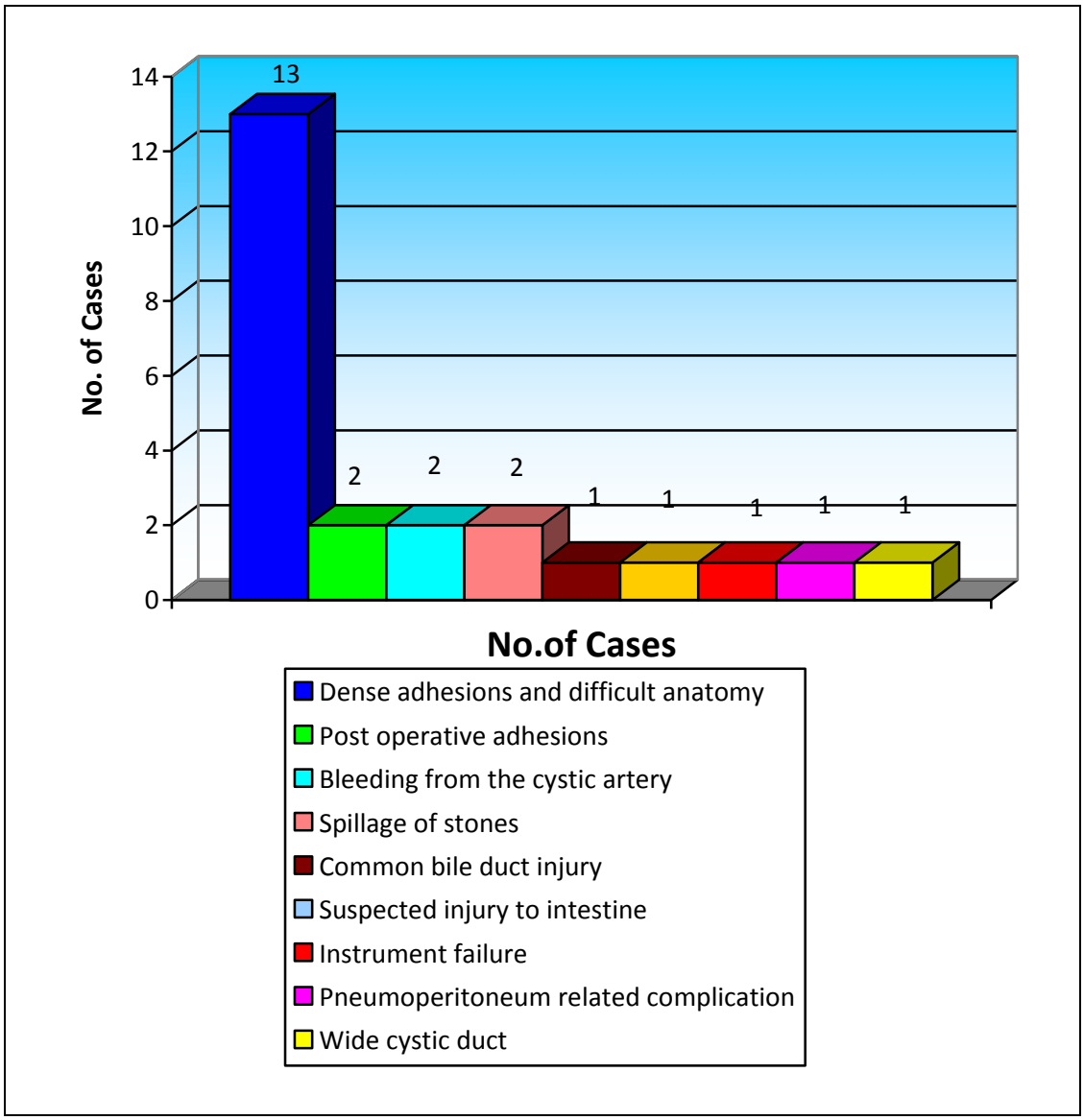
RESULTS

Two hundred and seventy six patients were posted for laparoscopic cholecystectomy for cholelithiasis without choledocholithiasis were selected. 24 patients of 276 cases who underwent laparoscopic cholecystectomy of posted cases had to be converted to open cholecystectomy for various reasons. They are depicted in Table 1.Fig.1.

Table 1: Various reasons for conversion of laparascopic cholecystectomy to open method cholecystectomy.

S. No	Reason for conversion to open cholecystectomy	No of cases	Percentage
1	Dense adhesions and difficult anatomy	13	54.16
2	Post operative adhesions	2	8.33
3	Bleeding from the cystic artery	2	8.33
4	Spillage of stones	2	8.33
5	Common bile duct injury	1	4.16
6	Suspected injury to intestine	1	4.16
7	Instrument failure	1	4.16
8	Pneumoperitoneum related complication	1	4.16
9	Wide cystic duct	1	4.16

Fig.1. Various reasons for conversion of laparascopic cholecystectomy to open method cholecystectomy.



The most common reason for conversion found in our study in the 24 cases that were converted to open cholecystectomy was dense adhesions between omentum and visceral organs to the gallbladder fossa in 13 patients leading to inability to define the anatomy clearly precluded to conversion in these cases. It is followed by previous history of

laparatomy with post operative adhesions leading difficulty in trocar placement and access to the peritoneal cavity. Also the vascular complications like bleeding from the cystic artery, other intraoperative complications like spillage of stones, common bile duct injury, inability to manage cystic duct laparoscopically and other complications like instrument failure and anesthesia related complication have also precluded to conversion.

Age and gender finding in our study

Age group of patients got converted ranges from 21 years to 72 years with mean age of 41.2 years.

Table 2: Distribution of male to female patients in the converted study group

Age group	Male	Female	Total
16-20	_	_	-
21-30	1	2	3
31-40	2	8	10
41-50	2	5	7
51-60	2	1	3
>60 years	1	_	1
Total	**8**	**16**	**24**

In the 252 patients in whom successful laparoscopic cholecystectomy completed out of 276 patients, males were 26 and females were 226 in number. 8 male cases out of 34 males had conversion at a ratio of 1:3 while in females, 16 cases out of 242 cases had conversion rate at a ratio of 1:15. This shows high incidence of conversion to open cholecystectomy in male gender although the females outnumbered males in the total number of cases of conversion.

Fig.2. Distribution of male to female patients in the converted study group

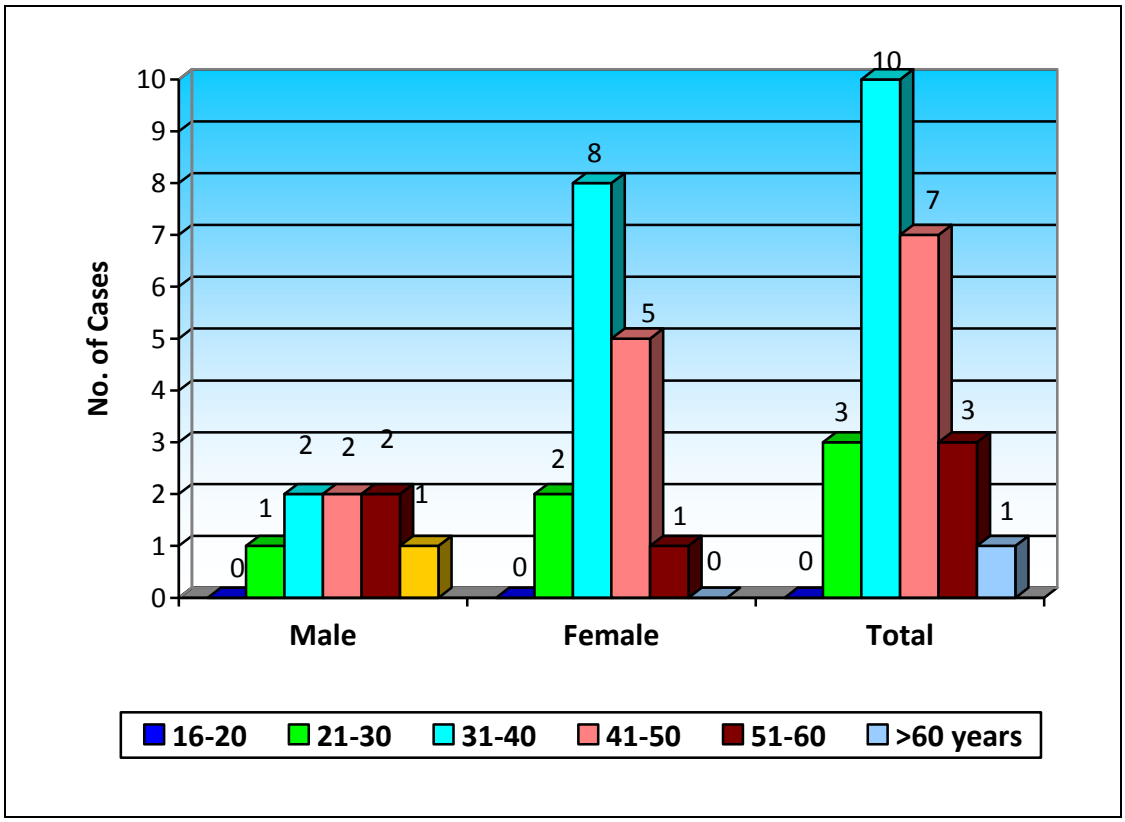


Table 3: Gender distribution among converted and successful laparoscopic group

	Male	Female	Total	Ratio
Converted group- (N=24)	8	16	24	1:2
Successful laparoscopy(N=252)	26	226	252	1:9
All cases	34	242	276	1:11

Fig. 3. Gender distribution among converted and successful laparoscopic group

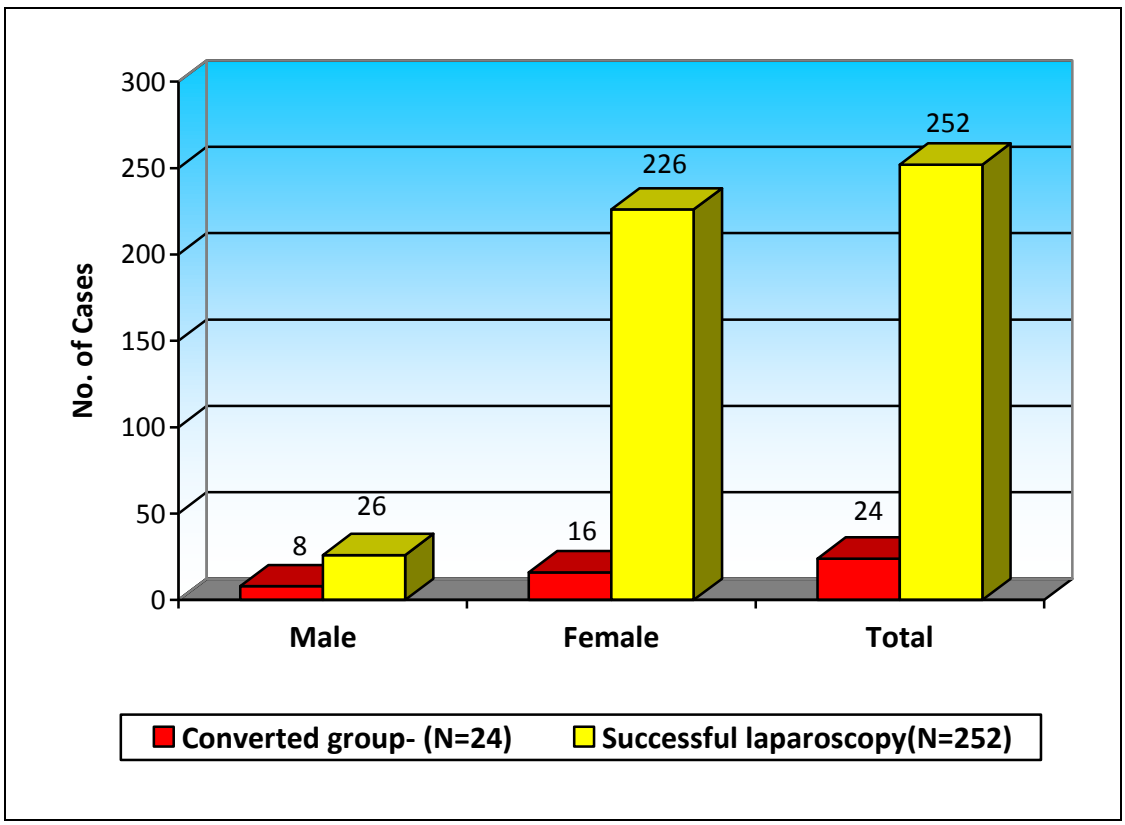


Table 4 : Distribution of associated factors among male patients in the converted group

S.No	Age	h/oacute holecystitis	h/o diabetes	Reasons for conversion
1	45	+	+	Dense adhesions
2	36	+	–	Dense adhesions
3	70	–	–	Spillage of stones
4	52	+	+	Dense adhesions
5	30	+	–	Wide cystic duct
6	47	+	–	Dense adhesions
7	56	–	–	Dense adhesions
8	32	–	–	CBDinjury
		5	3	

Out of 8 male patients, 5 patients had features of acute cholecystitis, and of those the reason for conversion was found out to be dense adhesions in 4 cases and wide cystic duct in one case. 3 patients were known diabetic among them and all three had history of acute cholecystitis.

Table 5 : Distribution of patients with acute cholecystitis

S. No	Age/ sex	DM	Wall thickness by Ultrasono Gram.	Pericho– lecystic Collection	Episodes	Reason of Conversion
1	45/M	+	Increased	+	2nd	Dense adhesion
2	32/F		Increased	–	2nd	Dense adhesion
3	36/M	+	Increased	+ (impacted)	1st	Empyma
4	32/F		Increased	+	2nd	Dense adhesion
5	47/M	+	Increased	–	3rd	Dense adhesion
6	35/F		Normal	–	2nd	Dense adhesion
7	52/M	+	Increased	+ (impacted)	1st	Empyema
8	40/F		Increased	+	2nd	Dense adhesion
9	21/F		No	–	2nd	Dense adhesion
10	40/F		No	–	2nd	Intestinal injury
11	30/F		Increased	–	3rd	Wide cystic duct

Table 5A.

Episodes of acute cholecystitis	No of cases (11)
First episode	2
Second episode	6
>2 episodes	3

In 11 patients with features of cholecystitis, 9 patients converted due to dense adhesions and of them two patients had empyema and diabetic. 9 patients had history of recurrent episodes of cholecystitis and two patients had first episode.

Table 6 : Ultrasonogram findings in the converted group

S.No.	Wall thickness	Peri cholecystic Collection	No of Calculi	Impacted stones
1	Increased	Present	Multiple	Present
2	Normal	None	Multiple	
3	Normal	None	Multiple	
4	Normal	None	Single	
5	Increased	None	Multiple	
6	Increased	Present	Multiple	Present
7	Normal	None	Sludge	
8	Normal	None	Multiple	
9	Not available	None	Multiple	
10	Normal	None	Multiple	
11	Increased	Present	Multiple	Present
12	Normal	None	Multiple	
13	Increased	None	Multiple	
14	Increased	Present	Multiple	
15	Normal	None	Sludge	
16	Increased	None	Single	
17	Normal	Not known	Multiple	
18	Normal	None	Multiple	
19	Normal	Not known	Multiple	
20	Normal	None	Multiple	
21	Normal	None	Multiple	
22	Normal	None	GB polyp	
23	Increased	Present	Multiple	Present
24	Normal	None	Multiple	
	9	5		4

Reason: Dense adhesion(n=13/24)

The most common reason for conversion in our study is dense adhesions between omentum and visceral organs to the gallbladder fossa in 13 out of 24 patients. Inability to define the anatomy clearly precluded to conversion in these cases

9 patients out of these 13 patients had clinical features and imaging suggestive of acute cholecystitis. All these 9 patients were admitted through emergency department.

Table 7 Number of Patients with Acute or Chronic Cholecystitis

	No. of patients with dense adhesions
Acute cholecystitis	9
Chronic cholecystitis	4

5 were male patients, 3 were diabetic and all three had history suggestive of acute cholecystitis and two of them had empyma gallbladder with dense adhesions

Table 8 : Mode of admission in patients with dense adhesions

Mode of admission	**No of cases**
Emergency	9
nonemergency	3

S.No.	Age/Sex	h/o acute cholecystitis	h/o Diabetes	Empyma GB	Mode of admission
1	45/M	+	+	_	E
2	46/F	_	_	_	NE
3	32/F	+	_	_	E
4	36/M	+	_	_	E
5	32/F	+	_	_	E
6	47/M	+	+	+	E
7	56/M	_	_	_	NE
8	35/F	+	_	_	E
9	21/F	+	_	_	NE
10	55/F	_	_	_	NE
11	32/M	+	+	+	E
12	39/F	_	_	_	NE
13	40/F	+	_	_	E
	13	9	3	2	8

II. Post operative adhesions:

Eight(8) patients had h/o previous abdominal surgery out of 276 patients. Two patients had to be converted to open method for operative adhesions .both of them had a history of laparotomy by midline incisions.

III. Spillage of stones:

Spilled stones was the cause of conversion in one patient who had multiple calculi spilled that was not able to be removed by suction and irrigation.

Fear of spillage was the cause for an other patient who had Gall Bladder distented and stretched with multiple stones.

IV.Bleeding from the cystic artery:

Uncontrollable bleeding from the cystic artery was the cause of conversion in two patients. Laparotomy was done through a right subcostal incision. Cystic artery bleeding was identified and controlled. Injury to other structures were also excluded.

V.Bile duct injury:

We had one patient converted to open method due to common bile duct injury in whom laparotomy was done. After assessing the bile duct injury hepaticojejunostomy was done by surgical gastroenterologist who was sought for help.

VI.Suspected injury to intestine:

We had one patient to be converted due to suspected injury to intestine. That patient was a case of chronic cholecystitis. She had undergone ERCP for choledocholithiasis and was posted for laparoscopic

cholecystectomy. After removal of gall bladder as we observed bile leak with cystic duct and gall bladder fossa excluded for bile leak, we suspected bowel injury and laparotomy was done. There was no obvious bowel injury present.

VII.Instrument failure:

In one patient who was obese, access to gall bladder fossa was difficult after trocar placement. Inability to define anatomy with restricted instrumentation lead to the decision of conversion. Instrument/ Equipment failure a cause of conversion as observed in studies by GO PMNYH*et al*. and Kumar *et al*.

VIII.Anasthesia related complication:

We had one patient to be converted as the patient developed bradycardia intra operatively which was not manageable. So the pneumoperitoneum was released and cholecystectomy was done through right subcostal incision.

IX.Wide cystic duct:

One conversion was due to inability to manage wide cystic duct by applying clip. As cystic duct closure by suturing was not feasible in this case laparoscopically.

DISCUSSION

In our study, we found 24 cases of laparoscopic cholecystectomy converted to open cholecystectomy out of 276 cases.

Incidence of conversion to open method is higher among male patients that are 8 out of 34 cases with a ratio of 1: 3 when compared to the female patients with conversion ratio at 1:15 like published in studies like Kanaan et al. It could have been due to the large number of difficult cholecystectomy observed in male patients while many studies in the high volume centres performing high number of laparoscopic cholecystectomy shown results at a rate of 1:7 to 1:20 cases. The results also can be explained due to the presentation after multiple episodes of cholecystitis in our study. This also partly explains the conversion observed in all the cases which was found to be at a rate of 1:11.

We had three diabetic patients in whom laparoscopic method was converted to open method. Diabetic patients are more prone for complications due to their altered immune status and prediction for conversion should be more if a diabetic patient with uncontrolled diabetic status and with features of acute cholecystitis, impacted gall stone.

We had about 13 patients with dense adhesions to omentum and visceral organs to the gallbladder fossa which was found out to be

primary reason behind in most of the conversions in our study. The difficulty in releasing adhesions is primarily due to inability to define anatomy lead to the conversion to open cholecystectomy and sometimes due to the injury of blood vessels or injury to the bowel.

The methods that can be done with dense adhesions to prevent the conversion can be approached laparoscopically by Laparoscopic subtotal cholecystectomy with fundus first method or Cholecystostomy in certain scenarios allows to exit from difficult situation, allowing the inflammation to subside and opportunity to do cholecystectomy in 6 to 8 weeks.

Factors associated with dense adhesions and thereby increasing the conversion rate are primarily cholecystitis particularly in the acute stage, older age group, Male gender and the co morbid conditions particularly diabetes mellitus and the timing of surgery after 72 hours, allowing adhesions difficult for the dissection laparoscopically as observed in the similar study by Cox MR et al. Koo et al observed conversion rate of 12% and 30% in patients operated within and after 72 hours in cases of acute cholecystitis. It describes the importance of decision making in deciding the timing of the surgery. Previous abdominal surgery postoperative adhesions lead to conversion in two cases. In both cases there were dense adhesions to parietal wall and gallbladder fossa. Adhesiolysis through laparoscopy was tried but access to release

adhesions was limited and fear of injury to bowel and CBD and other neighboring structures.

We had 72 patients with adhesions either from previous inflammation or in some cases previous surgery. Adhesiolysis was done laparoscopically by blunt and sharp dissection with use of cautery when needed. After adhesiolysis cholecystectomy was done in a routine manner. Owing to difficulty additional 5mm port was created for instrumentation and manipulation in some cases. Pneumo peritoneum could be carried out by open method like Fried G.M.*et al.* who used open insertion of initial port, and at times gained initial access through upper quadrant.

Spillage of stone in one patient and fear of spillage in other patient was the cause of conversion as shown by results from Frazee R.C. *et al.* In other cases with multiple calculi where we suspected spillage, gall bladder was retrieved with self designed retrieval bag which can be used in preventing spillage and subsequently the complications of it. If spillage was minimal as in many cases with tiny calculi and sludge, were managed with irrigation and suction.

The source of bleeding during laparoscopic cholecystectomy may be from the trocar site or during the adhesiolysis can result in bleeding from omentum which can be controlled by careful elecro cautery or

commonly due to the sudden pulsatile bleeding can occur from cystic artery unexpectectly and in some cases due to the anomalous vessels.

In our study, we had two cases of conversion due to the bleeding from the cystic artery. These vascular complications can be prevented by meticulous dissection and careful dissection by avoiding clipping blindly in panic and it can be approached by placing additional trocar can be placed for visualization and manipulation and gallbladder can be pushed against Calot's triangle providing temporary hemostasis and Irrigation and suction can show the exact site of bleeding to control using electro cautery. If these measures fail and bleeding is significant, laparatomy should be done. Also the roles of operating and assisting surgeon are important in identifying the bleeding vessels and also suspicions of anomalous vessels need to be remembered. Bleeding from gall bladder fossa can be a cause for conversion in cases like cirrhosis liver. In our study, we had no significant bleeding from the gall bladder fossa to the extent that needs conversion and all cases with minor oozing were treated with compression, Unlike in the studies by Perissa *et al and* Sanabria *et al* who observed significant cases of conversion due to it particularly in the cirrhotic patients.

We had one patient with bile duct injury. It was recognized intraoperatively suspecting bile leak and on further dissection exposed the trasected common bile duct which was mistaken for cystic duct was

clipped and cut. Laparatomy was done through a midline incision and the injury was assessed and with experienced surgeon, hepatico jejunostomy was done.

`It can be prevented by cephalad retraction of gall bladder which helps in making the cystic duct lie in line with common bile duct making it prone to injury which can be prevented lateral and superior retraction of infundibulum of gall bladder and also by avoiding the excessive retraction of gall bladder when clips were applied may injure common bile duct and also by avoiding excessive use of cautery near the triangle of Calot.

Inability to define anatomy with restricted instrumentation lead to the decision of conversion. Instrument/Equipment failure a cause of conversion as observed in studies by Gopmnyh*et al*. and Kumar *et al*.

CONCLUSION

An appreciation of these factors would predict the conversion that will allow appropriate planning by the patient, the institution, and the surgeon. Of the 276 patients in whom laparoscopic cholecystectomy was attempted, 26(9.4%) required conversion to open surgery. The most common reason for conversion was inability to define anatomy in patients with inflamed gallbladder (n = 13). Significant predictive factors for conversion were male gender, previous abdominal surgery, associated dibetes, acute cholecystitis and thickened gallbladder wall with pericholecytitic collection on preoperative ultrasonography.These factors are of more of importance when these factors are associated with each other than its independent presence in predicting difficult cholecystectomy.

SUMMARY

- The most common reason for conversion was inability to define anatomy in patients with inflamed gallbladder.
- Conversion is more common in males with features of acute cholecystitis than in females.
- Conversion is still more common in uncontrolled diabetic patients with feautures of acute cholecystitis and Risk of empyma gall bladder and gangrenous gall bladder and its complications with early precipitation of sepsis are common .
- Conversion is more common if surgery is delayed > 72 hours in the setting of acute cholecystitis from the onset of symptoms .
- Degree of difficulty relates to disease process, patient stability and technical ability.
- Safety measures for difficult cholecystectomy.
- Selective open technique of pneumoperitoneum.
- Surgeons should be familiar with the angled scope.
- Intra operative cholangiography if needed to indentity biliary anatomy and Bile duct stone.

- Adequate instrumentation
- Hydrodissection.
- Preliminary decompression
- Additional parts for retraction & exposure.
- Two hand technique of suturing & knotting capability.

ANNEXURES

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PROFORMA

CLINICAL PROFORMA

NAME : AGE : SEX :

I.P.NO : OCCUPATION :

ADDRESS :

DATE OF ADMISSION : DATE OF DISCHARGE :

DATE OF SURGEY :

MODE OF ADMISSION: EMERGENCY/ELECTIVE

CLINICAL PRESENTATION :

ABDOMINAL PAIN

VOMITING :

FEVER :

DYSPEPSIA :

ASYMTOMATIC :

HISTORY OF INTERVENTIONAL PROCEDURE :ERCP

PAST HISTORY :

ANY SIGNIFICANT ABDOMINALSURGERY

SIMILAR ILLNESS :

COMORBID CONDITION3 **:** DIABETIC ,HEART DISEASE

INVESTIGATION :

ULTRASONOGRAM :

LIVER FUNCTION TEST :

INTRA OPERATIVE FINDINGS :

REASON FOR CONVERSION IF DONE :

SURGERY DONE :

POSTOPERATIVE PERIOD :

COMPLICATION :

KEY TO MASTERCHART

Episode

A	–	First episode
B	–	Recurrent episode

Timing of Surgery

A	–	>72 hours (more)
B	–	<72 hours

USG Finding

INC	–	Increased Gallbladder Wall thickness
A	–	Pericholecystic Fluid collection.
No	–	No increased wall thickness.

Admission

E	–	Emergency
NE	–	Non Emergency

MASTER CHART

S.NO	NAME	Age	Sex	IPNO	REASONS FOR CONVERSION	ACUTE CHOLECYSTITIS	DIABETES	EPISODE	TIMING OF SURGERY	USG FINDING	ADMISSION
1	Murugesan	45	M	23412	Dense adhesions	Yes	Yes	B	A	INC/A	E
2	Lakshmi	46	F	35432	Dense adhesions	No	No	B	A	INC	NE
3	Manimegalai	47	F	54123	Spillage of stones	No	No	A	B	No	NE
4	Shanthi	48	F	45801	Cystic artery bleeding	No	No	B	B	INC	NE
5	Shyamala	32	F	32176	Dense adhesions	Yes	No	B	A	INC	E
6	Saravanan	36	M	30876	Dense adhesions	Yes	No	B	A	INC/A	E
7	Selvi	32	F	20433	Post operative adhesions	Yes	No	A	B	No	NE
8	Subbulakshmi	35	F	21366	Dense adhesions	Yes	No	B	A	INC	E
9	Pradeepa	21	F	47655	Dense adhesions	Yes	No	B	A	IINC	NE
10	Karuppan	70	M	73455	Spillage of stones	No	No	B	B	No	NE
11	Sadhsivam	52	M	31557	Dense adhesions with empyma gallbladder	Yes	Yes	B	B	INC/A	E
12	Rajeswari	55	F	44088	Dense adhesions	No	No	B	A	No	NE
13	Pandiarajan	30	M	32101	Wide cystic duct	No	No	B	B	INC	NE

14	Kalaiselvi	32	F	43285	Dense adhesions	Yes	No	B	A	INC/A	E
15	Pandimeena	36	F	22905	Postoperative adhesions	NO	No	B	B	No	NE
16	Rajendran	47	M	66143	Dense adhesions with empyma Gallbladder	NO	Yes	B	B	INC	NE
17	Kaleeswari	28	F	24738	Instrument failiure	Yes	No	B	B	No	E
18	Palaniyayi	62	F	14322	Pneumoperitoneum related complication	NO	No	B	B	No	NE
19	Karuppaiah	56	M	14721	Dense adhesions	Yes	No	B	A	No	E
20	Eswari	40	F	70245	Suspected intestinal injury	Yes	No	B	A	No	E
21	Selvi	39	F	54222	Dense adhesions	Yes	No	B	A	No	E
22	Subramanian	32	M	26438	Common bile duct injury	NO	No	B	B	No	NE
23	Chelladai	40	F	27647	Dense adhesions	NO	No	B	A	INC/A	E
24	Lalitha	47	F	10138	Cystic artery bleeding	NO	No	B	B	No	NE