

# Guidelines for Laparoscopic CBD Exploration

## INDICATIONS

Since the 1992 National Institutes of Health Consensus Development Conference Statement on Gallstones and Laparoscopic Cholecystectomy the indications for laparoscopic operations on the gallbladder and biliary tree have not changed; they remain similar to the indications for open surgery with relative and absolute contraindications as noted below. As stated in the NIH report “a patient with symptomatic gallstones can be a right candidate for laparoscopic cholecystectomy, if they are able to tolerate general anesthesia and have no serious cardiopulmonary diseases or other co-morbid conditions that hinder operation”. The included indications are not limited to symptomatic cholelithiasis, biliary dyskinesia, acute cholecystitis, and complications related to common bile duct stones including pancreatitis. Asymptomatic gallstones are an exception to it.

In general relative contra-indications for laparoscopic biliary tract surgery include many of the usual contra-indications for laparoscopic surgery. These include, but are not limited to, generalized peritonitis, septic shock from cholangitis, severe acute pancreatitis, untreated coagulopathy, lack of equipment, lack of surgeon expertise, previous abdominal operations which prevent safe abdominal access or progression of the procedure, advanced cirrhosis with failure of hepatic function, and suspected gallbladder cancer. Laparoscopic cholecystectomy may be performed safely in patients with cirrhosis and acute cholecystitis, but there are cases in which the open approach may be safer. Symptoms for planned open procedures include a patient’s informed request for an open procedure, known dense adhesions in the upper abdomen, known gallbladder cancer, and surgeon preference.

## ARRANGEMENT FOR THE SURGERY

1. Antibiotic Prophylaxis. Preoperative antibiotics in elective laparoscopic biliary tract surgery have been discussed with strong opinions on both sides. The usefulness of prophylaxis in high risk patients (age > 60 years, the presence of diabetes, acute colic within 30 days of operation, jaundice, acute cholecystitis, or cholangitis) remains uncertain while the most recent randomized, prospective study included in the above mentioned meta-analysis showed no difference in the postoperative wound infection rate, although the control group had a 1.5% infection rate and the antibiotic group had a 0.7% infection rate; since there was a total of 277 patients in the study, a Type II error might have been committed. A recent meta-analysis of randomized controlled trials depicted prophylactic antibiotics do not prevent infections in low risk patients undergoing laparoscopic cholecystectomy. Among papers suggesting antibiotic prophylaxis is helpful is a recent randomized study which found fewer wound infections with ampicillin-sulbactam versus cefuroxime, in particular for infection caused by enterococcus in the setting of high-risk patients undergoing elective cholecystectomy. Duration of use of antibiotics should be limited to a single preoperative dose given within one hour of skin incision, and re-dosed if the procedure is more than 4 hours long.

2. Deep Venous Thrombosis Prophylaxis: This prophylaxis is important for most laparoscopic biliary tract procedures and should consist of either pneumatic compression stockings or subcutaneous Heparin given prior to operation in patients with two or more risk factors.

## BASIC OPERATIVE TECHNIQUE

1. Room set-up and patient positioning. There are two processes for room set-ups for performing laparoscopic biliary tract surgery. The first is the standard supine position with the surgeon standing at the patient's left and monitors at the head of the bed on both sides. The second is with the patient in stirrups the surgeon standing between the legs. The former is commonly used in the America and latter in Europe. Some surgeons tuck the left arm to improve the working space of the operating surgeon. The patient is generally placed in a reverse Trendelenburg position and rotated right side up.

2. Equipment needed for laparoscopic cholecystectomy: The equipment needed for laparoscopic cholecystectomy and intraoperative cholangiography is well established with specific preferences left to the sole discretion of the operating surgeon. The equipment needed for laparoscopic common bile duct exploration is also at the discretion of the operating surgeon and should be available if that is a possibility when performing cholecystectomy.

3. Abdominal access: There are variety of techniques for gaining initial abdominal access for laparoscopic surgery; these include: 1) Veress needle. 2) The open Hasson technique. 3) Direct trocar placement without prior pneumoperitoneum. 4) The optical view technique, in which the laparoscope is placed within the trocar so that the layers of the abdominal wall are visualized as they are being traversed. In particular, above mentioned approaches to abdominal access are safe. A recent metaanalysis of 17 randomized controlled trials studying a total of 3,040 individuals comparing a variety of open and closed access techniques found no difference in complication rates; potentially life threatening injuries to blood vessels occurred in 0.9 per 1000 procedures and to the bowel in 1.8 per 1000 procedures. Currently, there are no demonstrable differences in the safety of open versus closed techniques for establishing access and creating the initial pneumoperitoneum, therefore decisions regarding choice of technique are left to the surgeon and should be based on individual training, skill, and case assessment.

4. Safe technique: The safety of laparoscopic cholecystectomy is based largely on determining the anatomy of the cystic duct, common bile duct, cystic artery and hepatic arteries. Due to duct misidentification major bile duct injuries with laparoscopic cholecystectomy are most frequently found symptoms, techniques for prevention and/or recognition focus primarily on careful anatomic definition to ensure the "critical view" prior to dividing any structures including dissection 1) to completely expose and delineate the hepatocystic triangle, 2) to identify a single duct and a single artery entering the gallbladder, and 3) to completely dissect the lower part of the gallbladder off the liver bed. Though the protective effect of the practice continues to be debated, routine use of intraoperative cholangiography may decrease the risk or severity of injury and improve injury recognition. The principle generally applied of not dividing any structure until you are certain of its identification is explained here; the need for caution and vigilance cannot be overstated given evidence which supports visual misperception as an underlying cause of major bile duct injury, coupled with the potential for complacency which may result from the rarity of bile duct injuries.

5. Common Bile Duct Assessment: During cholecystectomy are intraoperative cholangiogram and intraoperative ultrasound are the primary methods for assessing the common bile duct for stones or injury.

I. Intraoperative cholangiography has been used for many years; fluoroscopy saves time and its usefulness has improved. The issue of routine verses selective cholangiography has been long

debated. Studies have suggested routine use of intraoperative cholangiography may decrease the risk of injury and improve injury recognition while others have suggested cholecystectomy may be performed without cholangiogram with low rates of injury. In residency programs, to train residents how to do that portion of the procedure a policy of routine cholangiography may be supported by the need. In addition, the skills developed and maintained by routine cholangiography provide a platform for progression to transcystic clearing or stenting of the common bile duct; in many cases clearing can be accomplished with simple measures such as administration of glucagon and flushing with saline. In terms of detecting bile duct stones, recent studies suggest as many as 10% of these are unsuspected prior to operation, and 2-12% of patients will have choledocholithiasis on routine intraoperative cholangiogram. A meta-analysis performed in 2004 revealed that the incidence of unsuspected retained stones was 4% with only 15% of these going on to cause clinical problems. The conclusion from that study was that a selective policy should be advocated, though creating a reliable algorithm for predicting the presence of stones and thus the need for selective cholangiogram has been unsuccessful.

II. Laparoscopic ultrasound: This technique has been used increasingly; while by itself it does not offer potentially therapeutic access to the bile ducts, it does help delineate relevant anatomy including bile ducts and vascular structures, and can diagnose choledocholithiasis without opening the biliary system, all without exposure to ionizing radiation. Several recent studies have examined the use of laparoscopic ultrasound during cholecystectomy. Potential advantages and disadvantages of the technique have been summarized by Perry et.al.; advantages include high rates of successful studies, the ability to repeat the examination during difficult dissections, less time required for completion, and lower overall cost, while disadvantages include technical difficulties for certain patients, inability to confirm the flow of bile into the duodenum, and the experience required to learn the technique of examination and image interpretation. The use of the technique routinely with no reported bile duct injuries and minor bile leaks due to secondary to liver bed injury a rare event (0.2%), and with high sensitivity and specificity for the detection of common bile duct stones.

Management of choledocholithiasis 1. Approaches to suspected choledocholithiasis: With increasing laparoscopic expertise, exploration the common bile duct either via the cystic duct or by primary choledochotomy has become a viable option, but the treatment of symptomatic or suspected common bile duct stones in the era of laparoscopic cholecystectomy remains a complex and controversial issue. Leaving aside open cholecystectomy/bile duct exploration, which is superior to ERCP for stone clearance, as described by Kharbutli and Velanovich there are two approaches to patients with possible choledocholithiasis who are undergoing laparoscopic cholecystectomy, both for patients who are asymptomatic undergoing elective cholecystectomy, and for patients with recent episodes of jaundice or gallstone pancreatitis: (1) laparoscopic cholecystectomy with intraoperative cholangiogram, then address choledocholithiasis if found, or (2) preoperative ERCP to diagnosis and remove choledocholithiasis, followed by laparoscopic cholecystectomy. For choice (1), a number of additional choices are possible for stones found during intraoperative imaging studies: (A) transcystic laparoscopic common bile duct exploration, (B) common bile duct exploration via choledochotomy), (C) Placement of an endobiliary stent, (D) postoperative ERCP, and intraoperative ERCP. Several recent studies including at least two meta-analyses have attempted to compare the relative merits of the above approaches, and one stage treatment combining laparoscopic

cholecystectomy with laparoscopic common bile duct exploration usually prevails in terms of cost with no discernable difference in morbidity and mortality. With that said, pre-operative ERCP should not be used for diagnosis alone; routine pre-operative ERCP will likely result in a higher than acceptable mortality and morbidity rates with some unnecessary procedures. The single stage laparoscopic or the combined laparoscopic with intraoperative endoscopic approaches require time, equipment, and a degree of skill and experience which are not universal among surgeons and facilities performing laparoscopic cholecystectomy. Finally, post-operative ERCP leads to longer hospital stays with increased numbers of procedures required to treat the problem.

A. Transcystic common bile duct exploration: Given the scope of issues detailed above, the choice of technique to treat common duct stones will likely depend largely on local expertise. However, both short and long term data from a number of studies suggest transcystic common bile duct exploration, which may be augmented by choledocoscopy, is as safe and efficacious as other minimally invasive approaches. The postoperative course after successful transcystic clearance is similar to laparoscopic cholecystectomy alone. Transcystic stone clearance may be hampered by anomalous anatomy, proximal (hepatic duct) stones, strictures and large (>6mm) or numerous stones (>5).

B. Choledochotomy: Laparoscopic common bile duct exploration via choledochotomy requires advanced laparoscopic skills and longer operative times; as an alternative to failed transcystic exploration though some explore via choledochotomy exclusively, most see choledochotomy, all with generally good results in terms of stone clearance. The open bile duct may be addressed with closure over a T-tube, an exteriorized transcystic drain, or primary closure with or without endoluminal drainage. Closure over a T-tube may be required if the common bile duct is inflamed and in any case allows for postoperative radiographic evaluation of the biliary system, the possibility of a controlled biliary fistula and the possibility of extraction of retained stones, but can be complicated by premature dislodgement, bile leak and peritonitis, localized pain, prolonged fistula, and late biliary stricture. Studies comparing primary closure versus T-tube drainage suggest similar rates of complications with shorter operating times and a trend toward shorter hospital stays with primary closure.

C. Laparoscopic endobiliary stent placement: This treatment option for choledocholithiasis effectively bridges the gap between laparoscopic common bile duct exploration and ERCP; the technique involves placing a stent through the cystic duct into the common bile duct and across the ampulla of Vater, then closing the cystic duct. The advantages of this approach include decompression of the biliary tree allowing the option of semi-elective postoperative ERCP which for most patients maintains the minimally invasive approach and ambulatory nature of laparoscopic cholecystectomy; the stent adds little operative time to the procedure, the stent facilitates ERCP and stone clearance while potentially reducing the incidence of post-ERCP pancreatitis, and deployment does not require advanced laparoscopic skills.

D. ERCP with stone extraction: ERCP with stone extraction is another alternative when faced with choledocholithiasis; it may be performed before, during or after cholecystectomy. As discussed by Costi et.al., "performing ERCP before surgery raises questions regarding patient selection because systematic preoperative ERCP before LC means an intolerably great number of unnecessary and potentially harmful procedures. Complex scoring systems aimed at identifying asymptomatic

patients to undergo ERCP have not been adopted as clinical practice, nor have new examinations such as echoendoscopy and biliary magnetic resonance imaging (MRCP), which are costly and not always available. Performing ERCP contextually to LC implies organizational problems concerning the availability of an endoscopist in the operating theater whenever needed. Finally, performing ERCP after surgery would raise the dilemma of managing CBD stones whenever ERCP fails to retrieve them because a third procedure would then be needed." With no discernable difference in morbidity and mortality and similar clearance rates when compared to laparoscopic common bile duct exploration, duct clearance with postoperative ERCP is a viable alternative. While, in experienced hands, the two approaches are at least equivalent, there are surgeons for whom the preferred approach is ERCP with stone extraction. However, unless performed intraoperatively, ERCP requires at least one additional procedure, and does have associated complications such as pancreatitis, bleeding, and duodenal perforation, and as noted above, ERCP may fail, leading to multiple procedures for stone clearance. As described by Karaliotas et.al., the following entities increase the possibility of failure of endoscopic CBD stone clearance: stone impaction, gastrectomy or Roux-en-y anatomy, recurrent bile duct stones after prior open exploration of the CBD and biliodigestive anastomosis, periampullary diverticula, and Mirizzi syndrome.

2. Altered anatomy: Rearrangement of the upper gastrointestinal tract can make it difficult, if not impossible, to perform standard ERCP. It becomes ever more likely that surgeons will encounter patients who have gallstone disease and limited endoscopic access to the biliary system, With the recent increase in the number of Roux-en-Y gastric bypass procedures performed for morbid obesity. As described by Ahmed et.al, options for treatment include percutaneous transhepatic instrumentation of the common bile duct, percutaneous transgastric ERCP, laparoscopic transgastric ERCP, transenteric ERCP, retrograde endoscopy in which the scope is passed antegrade down to the jejunojejunostomy and then retrograde up the biliopancreatic limb, and open or laparoscopic common bile duct exploration.

G. Dissection of the gallbladder from the liver bed: To start from the gallbladder infundibulum and work superiorly using electrocautery to remove the gallbladder from the bed is the conventional technique for dissection of the gallbladder from the liver bed. The technique of top down dissection has also been advocated, particularly in cases with significant inflammation. Ultrasonic dissection has been studied for dissection of the gallbladder from the liver bed, as well as division and sealing of the cystic artery and cystic duct without clips; in prospective randomized trials, ultrasonic dissection has been found to be comparable in terms of operative times, gallbladder perforation, bleeding, and bile leak. In addition, hydrodissection with a high-pressure water stream has been used to dissect the gallbladder from the liver bed. The standard technique works well and, with no compelling data to use these alternative techniques, the choice is left to the operating surgeon.

H. Extraction of the gallbladder: The gallbladder is generally extracted from either the epigastric port or the umbilical port. The decision is left up to the operating surgeon. Some surgeons use a 5 mm port in the epigastric position, necessitating removal through the umbilicus. Likewise, most difficult extractions due to the large size of the gallbladder should be done through the umbilicus because it is easier to expand the fascial incision. The use of an endoscopic bag is also at the discretion of the operating surgeon. There are no randomized studies to guide use of these techniques.

I. Use of drains: While use of drains postoperatively after laparoscopic biliary tract surgery is at the discretion of the operating surgeon, recent studies including a randomized controlled trial and meta-analysis of 6 randomized controlled trials found drain use after elective laparoscopic cholecystectomy increases post-operative pain, wound infection rates and delays hospital discharge.

J. Conversion to laparotomy: To convert from laparoscopic to open cholecystectomy should not be considered a complication, but is rather an attempt to avoid complications and ensure patient safety. Following factors which are associated with conversion to open cholecystectomy include: acute cholecystitis with a thickened gallbladder wall, previous upper abdominal surgery, male gender, advanced age, obesity, bleeding, bile duct injury, and choledocholithiasis. Ultimately, individual surgeons must base the decision to convert to an open procedure on their own intraoperative assessment, weighing the severity of inflammatory changes, clarity of the anatomy, and their skill/comfort in proceeding. Overall conversion rates have been reported to be between 2-15%, and in cases of acute cholecystitis from 6-35%.

A. Access injuries: Establishing access and creating the initial pneumoperitoneum necessary to perform laparoscopic biliary tract procedures may lead to significant complications. Reviews of data regarding device-related injury and death as reported to the Food and Drug Administration (FDA) as well as thorough reviews of the available literature suggest vascular and visceral injuries are the major causes of morbidity and mortality related to abdominal access. Difficult to gauge The true rates of injury; injuries are probably underreported both to the FDA and in the literature, and there is a paucity of prospective data, but it is likely that injuries which occur while establishing pneumoperitoneum account for a significant proportion of complications during laparoscopy. Laparoscopic cholecystectomy is the procedure most frequently associated with both fatal and nonfatal trocar injuries, and almost all fatal injuries were made with shielded or optical trocars. A recent metaanalysis of 17 randomized controlled trials studying a total of 3,040 individuals comparing a variety of open and closed access techniques found no difference in complication rates; potentially life threatening injuries to blood vessels occurred in 0.9 per 1000 procedures and to the bowel in 1.8 per 1000 procedures. Currently, there are no demonstrable differences in the safety of open versus closed techniques for establishing access and creating the initial pneumoperitoneum, therefore decisions regarding choice of technique are left to the surgeon and should be based on individual training, skill, and case assessment. A high index of suspicion and prompt conversion to laparotomy are required to recognize and treat complications related to access.

B. Common bile duct injuries: A great deal continues to be written about bile duct injuries in laparoscopic cholecystectomy, which serves to underscore the seriousness of the complication and the perception that it can and should be avoided. The present rate of major bile duct injury in laparoscopic cholecystectomy has stabilized at 0.1-0.6% and series with no major bile duct injuries have been reported; while many believe the rate of major bile duct injury in open cholecystectomy is lower than laparoscopic cholecystectomy, controversy remains. A host of factors have been associated with bile duct injury including surgeon experience, the patient's age, male sex, and acute cholecystitis, though the effect acute cholecystitis has on injury rates remains controversial. Bile duct injuries which occur with laparoscopic cholecystectomy frequently involve complete disruption and excision of ducts, and may be associated with hepatic vascular injuries. If major bile duct injuries do occur, outcomes are improved by early recognition and by referring patients immediately to experienced specialists for further diagnosis and treatment, whether recognized at the time of the

primary operation or in the postoperative period. Repair should not be attempted by the primary surgeon unless the primary surgeon has significant experience in biliary reconstruction. Since major bile duct injuries with laparoscopic cholecystectomy are most frequently due to duct misidentification, definition to ensure the “critical view” techniques for prevention and/or recognition focus primarily on careful anatomic prior to dividing any structures and though the protective effect of the practice continues to be debated, use of intraoperative cholangiography may decrease the rate or the severity of common bile duct injury.

## **SPECIAL CONSIDERATIONS**

A. Biliary dyskinesia: Patients with abnormal gall bladder emptying may benefit from laparoscopic cholecystectomy, but with symptoms of biliary obstruction without evidence of gallstones. Symptoms may include episodic, severe, steady pain, frequently with fatty food intolerance, located in the right upper quadrant or epigastrium, with or without radiation to the back or shoulder lasting at least 30 minutes but less than several hours, and may potentially be associated with nausea and vomiting. Abnormal gallbladder emptying is usually defined as a gallbladder ejection fraction of less than 35% with cholescintigraphy after injection of cholecystokinin. Severe symptoms, a very low gallbladder ejection fraction (<14%), and reproduction of symptoms with cholecystokinin administration may be more predictive of resolution of symptoms after cholecystectomy. In patients, stones are found in specimens 10-12% of the time indicating a significant false negative rate for gallbladder ultrasound in this group of patients, who undergo laparoscopic cholecystectomy for biliary dyskinesia.

B. Acute cholecystitis: About 10-15% of all cholecystectomies performed are for acute cholecystitis. Laparoscopic cholecystectomy has become the preferred approach in patients with acute cholecystitis with rates of conversion to an open procedure of 6-35%. For patients who can tolerate the procedure, early cholecystectomy (within 24-72 hours of diagnosis) in cases of acute cholecystitis is increasingly advocated; when compared to planned open and/or delayed cholecystectomy, early laparoscopic cholecystectomy reduces the rate of symptom relapse, may be performed without increased rates of conversion to an open procedure, without an increased risk of complications, including bile duct injury, and early laparoscopic cholecystectomy may decrease cost and total length of stay. In critically ill patients with acute cholecystitis, radiographically guided percutaneous cholecystostomy is an effective temporizing measure until the patient recovers sufficiently to undergo cholecystectomy. Laparoscopic cholecystectomy in the elderly (age > 65 years) may be associated with higher morbidity and mortality.

C. Gallstone pancreatitis: Acute pancreatitis caused by gallstones is an important indication for cholecystectomy. The incidence of acute pancreatitis due to gallstones appears to be increasing. Based on a study of one large state’s discharge data, one-third of cases of acute pancreatitis among US adults are caused by gallstones with an incidence of gallstone pancreatitis of approximately 14.5 per 100,000, which translates into 31,500 cases per year nationally. While laparoscopic cholecystectomy has become the preferred approach for removing the source of stones, the timing of the cholecystectomy, as well as the choice and timing of procedures for evaluating and clearing associated common bile duct stones, remain controversial, particularly in cases of mild, self-limited gallstone pancreatitis. There is agreement that severe pancreatitis with ongoing multi system organ

failure requires immediate clearing of any biliary obstruction, usually with ERCP, followed by supportive care until the patient recovers sufficiently to tolerate cholecystectomy. However, when pancreatitis caused by gallstones is mild and self limited, the issue becomes preventing recurrent episodes of biliary symptoms, including acute pancreatitis. Currently, when symptoms have subsided and laboratory values have normalized, the majority of surgeons advocate and perform cholecystectomy urgently, usually during the same hospital admission, while others delay cholecystectomy for weeks; decision making algorithms regarding approaches to pre- versus intraoperative common bile duct evaluation and clearance are even more provider dependent, though patients with mild pancreatitis generally do not benefit from preoperative ERCP. A recent meta-analysis showed no difference in morbidity and mortality when endoscopic removal of common bile duct stones with cholecystectomy was compared to cholecystectomy with intraoperative removal of common bile duct stones.

D. Laparoscopic cholecystectomy surgery in the setting of cirrhosis. Cirrhosis places patients at an increased risk for gallstone formation. Since the NIH consensus conference on gallstones and laparoscopic cholecystectomy in 1992 suggested patients with cirrhosis were “not usually candidates for laparoscopic cholecystectomy” studies continue to be published supporting the safety of the approach in patients with Child’s A or B cirrhosis (including downgrading from C after appropriate treatment) with almost no data using the MELD score to compare patients; though there is little published data for Child’s C patients, what is available suggests it should be avoided in favour of non-operative approaches such as percutaneous cholecystostomy. Recent studies generally agree laparoscopic cholecystectomy in selected cirrhotics has a relatively low conversion rate (0- 11%), complication rate (9.5-21%), and risk of dying (0-6.3%), with most showing worsening liver failure, including the presence of ascites and coagulopathy, predicting poorer outcomes; a recent prospective randomized trial found laparoscopic cholecystectomy was safer than open cholecystectomy in cirrhotics. Some authors have suggested laparoscopic subtotal cholecystectomy as an alternative to laparoscopic cholecystectomy. Most authors caution that bleeding is the most frequent and worrisome complication suggesting that coagulopathy and thrombocytopenia be corrected preoperatively, and that dilated pericholecystic and abdominal wall veins or recanalized umbilical veins be treated with care, with one author noting “conversion to open does not correct coagulopathy”.

E. Laparoscopic cholecystectomy in the setting of systemic anticoagulation: There are at least two recently published studies of patients taking warfarin for long term systemic anticoagulation, but there is little published data regarding laparoscopic cholecystectomy in the setting of systemic anticoagulation. In both, patients had their warfarin discontinued and were bridged to surgery with low molecular weight heparin as inpatients, and laparoscopic cholecystectomy was performed after their INR was 1.5 or less. In one study of 44 anticoagulated patients, postoperative bleeding was significantly more common in the oral anticoagulation group (25%) versus the control group (1.5%), and in the majority of cases, bleeding in the oral anticoagulation group was serious, requiring blood transfusion or reoperation with a concomitantly longer hospital stay with standard laboratory tests not predicting postoperative hemorrhage, while the other study with 33 anticoagulated patients reported no bleeding complications. Based on similar rates of bleeding from other studies of laparoscopic procedures reviewed by the authors, caution in chronically anticoagulated patients is warranted, particularly in those requiring bridging with low molecular weight heparin.

F. Porcelain gallbladder: There is relatively little published data regarding the relationship between the two with almost no published data from this decade the relationship between calcification of the gallbladder wall and gallbladder cancer has been often-repeated; however. One of the most recent available studies from 2000 reviewed pathological findings from 25,900 cholecystectomies over 27 years; there were 150 gallbladders with cancer and 44 with calcified walls, 17 with complete intramural calcification (the classic porcelain gallbladder) and 27 with selective mucosal calcification. None of the specimens with complete intramural calcification had concomitant associated cancer while only 2 of the 27 with selective mucosal calcification had associated cancer correlating with a 5% incidence in calcified gallbladders (0% in true porcelain gallbladders). There is one study from 2004 addressing calcified gallbladders in laparoscopic cholecystectomy with 13 of 1,608 laparoscopic cholecystectomy specimens having calcified walls, again noting no cancer in 10 gallbladders with complete intramural calcification while 1 of 3 specimens with selective mucosal calcifications had associated cancer, which suggests patients with suspected calcifications should be carefully studied, with open cholecystectomy recommended for those with selective mucosal calcifications.

G. Gallbladder polyps: Polypoid lesions of the gallbladder, which can be found in about 9.6% in Asian populations and 1-5% of adults on ultrasound in Western populations, are defined as elevations of the gallbladder mucosa. Polypoid lesions of the gallbladder can be true polyps which demonstrate neoplastic changes and may be benign, dysplastic or malignant, or can be pseudopolyps such as cholesterol polyps, inflammatory polyps, or adenomyoma which are all benign. Gallbladder polyps are most frequently cholesterol polyps, which are usually small (less than 1cm) and multiple, and tend to remain stable with regard to size and number. Patients with cholesterol polyps usually do not develop concomitant stones or symptoms. A recent comparison of preoperative ultrasound findings with pathological examination of cholecystectomy specimens in Western patients suggests size is the only reliable indicator for malignant potential with all malignancies found in polyps greater than 6mm though non-Western populations may develop malignancy in smaller polyps. There are no randomized studies to direct decisions regarding gallbladder polyps and despite recent studies, the management of gallbladder polyps remains controversial. A reasonable approach would include laparoscopic cholecystectomy for larger, especially single, polyps or those with associated symptoms with watchful waiting for small (<5mm) asymptomatic polyps.

I. Gallbladder cancer. The incidence of gallbladder cancer in the US is 1.2/100,000; survival is extremely poor, the only curative therapy is surgical resection, and except for those with early stage disease. Gallbladder cancer is found unexpectedly upon pathological examination in less than 1% specimens after laparoscopic cholecystectomy. Laparoscopic cholecystectomy is considered curative for cancers confined to the gallbladder mucosa (T1a), while cancers which invade the muscularis (T1b) may have lymph node metastases or lymphatic invasion which prompts some authors to recommend hepatoduodenal lymph node dissection for these lesions, but an initial open versus laparoscopic approach does not influence survival. Inadvertent opening of cancerous gallbladders during laparoscopic cholecystectomy increases the likelihood of recurrence and port site metastases. Cancers which are more locally advanced or those with nodal involvement should be referred to specialty centers for consideration of more extensive resection or re-resection.

## **POSTOPERATIVE MANAGEMENT**

A. Length of stay: Patients undergoing uncomplicated laparoscopic cholecystectomy for symptomatic cholelithiasis may be discharged home on the day of surgery. Control of postoperative pain, nausea, and vomiting are important to successful same day discharge, and admission rates despite planned same day discharge are reported to be 1-39%; patients older than age 50 may be at increased risk for admission. Readmission rates range from 0-8%; common causes for readmission after same day discharge include pain, intrabdominal fluid collections, bile leaks, and bile duct stones. Time to discharge after surgery for patients with acute cholecystitis, bile duct stones, or in patients converted to an open procedure should be determined on an individual basis.

## **REDUCED PORT AND SINGLE INCISION LAPAROSCOPIC CHOLECYSTECTOMY**

All parts apply to reduced port and single incision approaches to laparoscopic cholecystectomy. The indications, contra-indications and preoperative preparation for reduced port and single incision approaches are the same as those for multi port cholecystectomy. Access and equipment, are, in their essentials, the same for reduced port and single incision approaches and multiport procedures. Should follow accepted standards for safe entry including avoidance and recognition of complications for access to the abdominal cavity in reduced port and single incision approaches. Standard instruments may be used in single incision or multi port procedures. With respect to specialized access devices and non-rigid instruments, there have been no trials or adequate evaluative studies yet published to offer any recommendation for these devices. Introduction of new instruments, access devices or new techniques should be done with caution and/or under study protocol, and, prior to the addition of any new instrument or device, it should, to the extent possible, be proven safe, and not limit adherence to established guidelines for safe performance of laparoscopic cholecystectomy. Adequate training should be obtained on any new device or instrument prior to utilization in a patient. As with any new technique, of outcomes should be continuously assessed to ensure continued patient safety as single incision techniques are developed; to date, only studies with limited numbers of patients have been reported. Dissection performed during single incision procedures should follow "best practice" approaches recommended for multiport cholecystectomy including dynamic traction of the fundus of the gallbladder, dynamic lateral retraction of the gallbladder infundibulum, and identification and maintenance of the "critical view" of the cystic duct and artery to avoid inadvertent injury to the common bile duct or hepatic arteries. During initial procedures, a low threshold for using additional port sites should be maintained so as to not jeopardize a safe dissection and result.