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The Difficult Cholecystectomy

Vincenzo Villani, MD; Lilian S. Kao, MD, MS; Yuman Fong, MD, DSc

IMPORTANCE Difficult cholecystectomies are associated with a higher risk of severe bilio-vascular injuries.

OBSERVATIONS Obesity, cirrhosis, high American Society of Anesthesiologists score, previous abdominal operations, and presence of acute cholecystitis or common bile duct stones are associated with difficult cholecystectomies. On imaging, thickened gallbladder wall, pericholecystic fluid, and an impacted gallstone are associated with difficult cholecystectomies. In challenging operations, the use of imaging (intraoperative cholangiography, intraoperative ultrasound, near-infrared cholangiography) is recommended. If the critical view of the hepatocystic triangle cannot be safely achieved, bailout strategies, such as tube cholecystostomy, subtotal cholecystectomy, or an anterograde approach, should be considered. Conversion to open surgery should be considered for significant bleeding, cholecystoenteric fistula, Mirizzi syndrome, or malignancy. Seeking advice or assistance from another surgeon is recommended when conditions are challenging.

CONCLUSIONS AND RELEVANCE Knowledge of perioperative and intraoperative adjuncts and alternative surgical options aid surgeons in performing difficult cholecystectomies safely.

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Author Affiliations: McGovern Medical School at the University of Texas Health Science Center at Houston, Houston (Villani, Kao); Department of Surgery, City of Hope National Medical Center, Duarte, California (Fong).

Corresponding Author: Yuman Fong, MD, Department of Surgery, City of Hope National Medical Center, Pavilion 2nd Floor, Ste 2207, 1500 E Duarte Rd, Duarte, CA 91010 (yfong@coh.org).

Cholecystectomy is the most prevalent abdominal operation performed in the US, with more than 640 000 procedures completed in 2019. The bile duct injury (BDI) rate has decreased from a range of 0.50%[1] to 0.08% to 0.22%.[2,3] Even with low incidence rates, BDIs cause significant patient morbidity. Difficult cholecystectomies (DC) are associated with a higher risk of severe bilio-vascular injuries.

Unattainable critical view of safety (CVS)[4] is the leading cause of DC (**Figure 1**). This is usually due to inflammation or scars from previous surgery and is associated with longer operative times, higher rates of blood product requirements, conversion to open surgery, use of bailout procedures (subtotal cholecystectomy [SC], tube cholecystostomy), and biliary and vascular injuries.[5] Unanticipated intraoperative findings, such as aberrant anatomy, Mirizzi syndrome, cholecysto-intestinal fistula, concern for malignancy, or cirrhosis, also create challenges (**Table**).[6,7]

Predictors of DC

Patient Factors

Obesity is a significant risk factor for surgical morbidity, with a correlation between body mass index (BMI) and increased blood loss[8] and severe complications.[9] Male gender is associated with difficult abdominal operations.[10] Previous abdominal operations were considered in the past a relative contraindication to laparoscopic cholecystectomy (LC).[11] Although no longer a contraindication, there is robust evidence that prior operations are a risk factor for DC[12] and conversion to an open procedure.[13] A higher American Society of Anesthesiology score is also associated with higher intraoperative difficulty.[14]

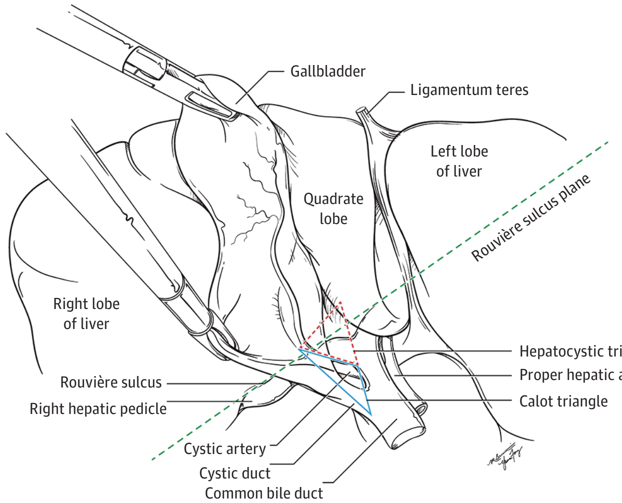
Cirrhosis represents a clinical challenge for patients needing abdominal surgery and LC is no exception. A 2003 meta-analysis showed increased operative times, conversion rates, bleeding complications, and morbidity in patients with cirrhosis undergoing LC vs those without cirrhosis.[15] Severe thrombocytopenia, ascites, or extensive cavernous transformation on cross-sectional imaging should encourage referral to surgeons accustomed to operating on patients with severe portal hypertension or consideration of nonoperative approaches.[16] In case of cirrhosis discovered incidentally at the time of the operation, it is important to carefully monitor the patient postoperatively for signs of hepatic decompensation. Fluid management should be judicious intraoperatively and postoperatively, and therapy with diuretics may help avoid reaccumulation of ascites. Transfer to a higher level of care or a transplant center should be considered early in the postoperative course.

Disease Presentation

Inflammation associated with calculous disease is the foremost cause of DC, particularly acute cholecystitis (AC)–associated inflammation.[17] Clinical severity of AC is graded per the Tokyo guidelines (TG), a system based on clinical indicators of inflammation severity and organ dysfunction.[18,19]

Studies have validated TG severity grade to correlate with length of stay, inability to achieve CVS, conversion to open surgery, complications, BDIs, and mortality.[20,21] Acute inflammation markers, such as elevated white blood cell (WBC) count and C-reactive protein, are linked to more difficult operations.[22] WBC count higher than 18 000 per mm^3 was one of the original TG criteria for moderate severity and remains in the current iteration.[19] Delayed presentation or

Figure 1. Key Anatomic Landmarks for Cholecystectomy and Achieving Critical View for Safety (CVS)



With the fundus of the gallbladder retracted cephalad, the infundibulum is retracted laterally to expose the hepatocystic triangle and the Calot triangle. Identification of the Rouvière sulcus (also called the fissure of Gans) and the base of the ligamentum teres then allows the plane of the sulcus to be defined. Behind this plane, clear visualization of anatomic structures is necessary for safe dissection. In particular, the cystic duct and cystic arteries need to be seen clearly in this area before transection. If inflammation precludes visualization of anatomic structures in these areas, alternatives to classic cholecystectomy should be considered.

Table. Conditions Defining a Difficult Cholecystectomy

Conditions	Risk factors
Patient factors	Obesity Male gender ASA score Aberrant anatomy
Inability to achieve CVS	Acute cholecystitis Mirizzi syndrome Cholecysto-enteric fistula Aberrant anatomy
Cirrhosis and portal hypertension	Thrombocytopenia Portal hypertension and cavernous transformation
Concern for malignancy	Polyps Incidental mass Jaundice and mass

Abbreviations: ASA, American Society of Anesthesiology; CVS, critical view of safety.

delayed intervention correlate to higher rates of difficult operations, likely due to more organized fibrosis around critical structures.[23,24] Patients with TG grade III severity of AC should be considered for nonoperative treatments, such as cholecystostomy tube drainage.

Imaging Findings

In the acute setting, most patients undergo a right upper-quadrant ultrasound before a cholecystectomy. Classic imaging findings of AC on ultrasound include a distended gallbladder, pericholecystic fluid, thickened gallbladder wall, and an impacted stone at the neck of the gallbladder. Of these, a thickened gallbladder wall of more than 3 to 5 mm,[25,26] pericholecystic fluid,[27] and impacted gallstone[22] were associated with DCs. Common bile duct (CBD) stones or CBD dilation are strongly correlated with more difficult operations,[10] postoperative morbidity,[28] conversion to open surgery[29] or other bailout procedures.[26]

Computed tomography is readily available at hospitals and widely used to diagnose causes of abdominal pain. It is less sensitive in delineating biliary anatomy than magnetic resonance cholangiopancreatography (MRCP). It is informative for suspected malignancy or evaluating cirrhosis and its severity. Radiologic findings of severe cirrhosis, such as ascites, abdominal wall and falciform varices, and cavernous transformation of the porta hepatis, should encourage a nonoperative approach if possible.

MRCP is recommended in patients with suspected choledocholithiasis[30] or suspicion of Mirizzi syndrome. Preoperative jaundice or severe derangements of liver functions should prompt an MRCP. Most studies agree that MRCP increases the likelihood of correctly diagnosing choledocholithiasis and some show a protective effect on perioperative complications,[31] though others do not.[32] On MRCP, disruption of the common hepatic duct, thickness, and signal intensity of the gallbladder wall are associated with longer operations and more bailout procedures.[33,34]

Imaging Characteristics of Possible Cancer

Gallbladder malignancies present in 3 ways. One in 100 cholecystectomies has a small, incidental gallbladder cancer (GBC) at pathologic analysis.[35] Even in retrospect, most are not definitively visible on preoperative scanning. Some present as incidentally discovered gallbladder polyps on imaging. Polyp characteristics that should alert the surgeon of malignant potential are (1) single, (2) sessile, (3) large (more than 1 cm), and (4) showing growth.[36] A gallbladder mass, particularly with accompanying lymphadenopathy without AC, is worrisome for GBC and should be referred to an oncology team for definitive therapy. Jaundice, mass at porta hepatis without AC, or imaging finding consistent with Mirizzi syndrome, is highly likely to be incurable GBC.[37] Biopsy, stenting of the biliary obstruction, and systemic therapy should be considered.

Management of the Difficult Gallbladder

Successful management of the difficult gallbladder relies on early identification of risk factors, use of preoperative adjuncts, knowledge of alternatives to cholecystectomy, skilled operative intervention, and appropriate bailout strategies.

Nonoperative Management

Not all patients with AC require surgery. Per TG, biliary drainage is an option for patients with moderate AC and poor performance status and those with severe cholecystitis with high surgical risk.[38] Biliary drainage can be obtained via interventional radiology-guided percutaneous (IR-PTC) transhepatic route, endoscopically via endoscopic retrograde cholangiopancreatography–guided nasobiliary drainage/cystic duct stenting, or endoscopic ultrasound-guided gallbladder drainage.[39] A prospective multicenter trial[40] and recent meta-analyses favor endoscopic ultrasound-guided gallbladder drainage over IR-PTC in terms of adverse events, readmissions, and recurrent cholecystitis.[41,42] However, IR-PTC may be technically superior.[42] When contemplating biliary drainage, one should consider expertise and success rate of local interventional radiologists and advanced endoscopists.

Optimal Timing for Intervention

The pendulum between early and delayed AC intervention has significantly swung toward early intervention, less than 72 hours after presentation. There is no convincing evidence that delaying intervention (letting the gallbladder cool off) significantly improves perioperative outcomes.[43,44] TG and the World Society of Emergency Surgery (WSES) guidelines strongly recommend early intervention.[45,46] A meta-analysis of 15 studies showed that early cholecystectomy (within 7 days from symptom onset) had similar mortality and morbidity compared with delayed cholecystectomy but with a shorter hospital stay and lower cost of care.[46] WSES conducted a meta-analysis of 14 trials comparing early (less than 7 days), intermediate (7 days to 6 weeks), and delayed cholecystectomy (6 weeks).[47] The early cholecystectomy group performed better in terms of serious adverse events. The intermediate cholecystectomy group had worst outcomes. Therefore, WSES recommends delaying cholecystectomy to more than 6 weeks if early cholecystectomy is not possible.[45]

Preparing for the Surgical Procedure

The Operating Room

The operating room table should be capable of fluoroscopy and adjusting the patient's position.[48] For a patient with obesity, placing a footboard is important to achieve steep reverse Trendelenburg positioning. If cholangiography is planned, it is advisable to review the equipment needed with the perioperative team. Bariatric trocars should be available for obese patients and placing a fifth port should be considered to aid with retraction and suction.

Access to the Abdomen

We recommend that surgeons use the most familiar technique. In the presence of upper midline laparotomy, access can be obtained away from the midline, with the dual goal of avoiding midline adhesions and positioning oneself at a vantage point to place additional ports and to start adhesiolysis.[49] Using a Veress needle at the Palmer point (or the right-upper quadrant), followed by an optical view trocar, may be appropriate for access in these cases. Using an ultrasound sliding sign can identify areas free of adhesions.[50]

Role of Robotic-Assisted Laparoscopy

The advantage of a robotic approach in LC is debated. A study based on US Centers for Medicare and Medicaid administrative claims of more than 1 million cholecystectomies (2010 through 2019) showed increased incidence of BDIs with robotic cholecystectomy (RC) (0.2 vs 0.7%).[51] Notably, the years included in this study preceded the widespread adoption of robotics in elective general and acute care surgery. Even by the last year included in the analysis (2019), only 5% of procedures were performed robotically.[51] More recent data show that RC implementation in emergency general surgery is equally safe and cost-effective compared with traditional laparoscopy.[52] Two recent studies have shown reduced conversions to open surgery with the robotic technique in emergency general surgery patients.[52,53] A National Surgical Quality Improvement Program database analysis similarly showed a lower conversion rate in cirrhotic patients undergoing RC. Some have argued for robotic-assisted cholecystectomy in particularly difficult anatomical situations, such as Mirizzi syndrome[54] and T2 GBC requiring an extended cholecystectomy.[55,56] While more studies are required to settle the robotic vs laparoscopy debate, if the technology and local expertise are available, this approach could be considered for challenging cases, such as known aberrant anatomy or cirrhosis.

Performing a Safe Cholecystectomy

Visual Scales to Predict Difficult Cases

Authors have developed visual scales to grade difficulty of a cholecystectomy. The Nassar, Parkland, and American Association for the Surgery of Trauma (AAST) scales are the most extensively quoted.[57,58] The Nassar scale, derived from more than 4000 cholecystectomies, is divided into 5 grades based on visual assessment of the gallbladder, the cystic pedicle, and adhesions.[59] Severity grade correlated with longer operative times, conversion to open procedures, complications, and reintervention on a multivariate analysis.[59] Upon entering the abdomen, a cursory view of the operative field gives the operating surgeon an idea of the difficulty, based on the Nassar or Parkland scale. For grade 3 or higher cases, a top-down dissection approach, SC, or even a drainage procedure should be considered.

Operative Technique

The sulcus of Rouvière (also called the Fissure of Gans) represents an important anatomical landmark (Figure 1). The imaginary plane (plane of sulcus) passing through the sulcus and base of the umbilical fissure divides a generally safe area (anterior to the plane) vs a potentially dangerous one (posterior to the plane). A complete initial anatomical assessment is the identification of the B-SAFE anatomical landmarks described by Schendel and colleagues[60]: B (bile duct), S (sulcus of Rouvière), A (left hepatic artery), F (umbilical fissure), and E (enteric structure, ie, duodenum).[60] Inflammation may obscure the landmarks, but the core principle still applies: identifying reliable landmarks helps with orientation and avoidance of dissection in potentially dangerous areas. A tunnel vision error may occur if one solely focuses on the infundibulum of the gallbladder. Orientation and reorientation must occur frequently.

In 2020, the Society of American Gastrointestinal and Endoscopic Surgeons Safe Cholecystectomy Task Force convened with experts from many societies and published the Multi-Society Practice Guideline on preventing BDI during cholecystectomy.[61] Per this guideline, CVS is recommended to identify the cystic duct over the top-down approach or the infundibular view. The classical technique to obtain CVS consists of properly retracting the gallbladder fundus cranially. A distended gallbladder should be aspirated to facilitate atraumatic retraction. The infundibulum is then retracted from the porta hepatis to open the hepatocystic triangle. The peritoneum overlying the infundibulum is scored with electrocautery (or stripped bluntly) and progressively dissected on the medial and lateral sides (Figure 1). Frequently reorientation by backing the camera out periodically and moving the gallbladder back and forth (waving the flag) can help with identifying the anatomy.[6] A meticulous dissection is performed on the hepatocystic triangle until 3 elements of CVS are obtained: (1) 2 tubular structures are visualized entering the gallbladder, (2) all fibroadipose tissue is cleared from the hepatocystic triangle, and (3) the lower third of the gallbladder is dissected off the cystic plate. Before transecting any structures, performing an intraoperative time out is recommended to verify the anatomy.[61] Photographic documentation is also suggested.[61]

Intraoperative Biliary Imaging

The Multi-Society Practice Guideline recommends liberal use of intraoperative biliary imaging (intraoperative cholangiogram [IOC] and intraoperative ultrasound [IUS]) to mitigate BDI risk.[61] Data supporting this come from 14 pooled studies based on more than 2.5 million cholecystectomies, showing a decreased BDI risk when IOC was used (odds ratio, 0.78%; $P < .001$).[61]

Laparoscopic ultrasound is an alternative to cholangiography. One retrospective cohort study (1995 to 2000) reported a 0% BDI incidence for patients who underwent LC with IUS, compared with a relatively high 2.5% BDI rate without IUS.[62] Meta-analyses show that IUS has a shorter learning curve and requires less time than IOC.[63]

Intravenous indocyanine green (ICG) and near-infrared optics for fluorescent cholangiography consist of a 2.5-mg ICG dose injected intravenously, followed by a 10-mL saline bolus, ideally given before surgery. A multicenter randomized clinical trial in Europe that included 294 patients showed reduced time needed to achieve CVS with ICG compared with conventional optics (19 minutes vs 23 minutes; $P < .03$).[64] Data from a meta-analysis showed that ICG had a higher visualization rate of biliary structures and there was decreased conversion to open surgery with ICG than with IOC.[65,66]

When CVS Fails

A recent meta-analysis showed failure to achieve CVS in 1% to 21% of cases.[67] Failure rates correlate with higher intraoperative difficulty scoring.[5] Persistence to achieve CVS in challenging cases can increase the risk of severe bilio-vascular injuries.[5] This is true with severe inflammation, chronically impacted stone in the infundibulum, Mirizzi syndrome, or when the tissue around the cystic duct, the infundibulum, and the cystic artery form a shield that is better left undisturbed.[68] A severely contracted or intrahepatic gallbladder can similarly pose significant challenges. When there is a lack of progress in dissection, an additional time-out is advisable.[69] In these situations, seeking advice and technical assistance from a colleague is encouraged.[61] The realization that CVS cannot be safely achieved represents an inflection point of the procedure and the surgeon should decide the ideal bailout option to safely complete the operation.[70]

Tube Cholecystostomy

When adhesions are so severe that only the gallbladder fundus can be identified, laparoscopic placement of a tube cholecystostomy is a safe bailout. In this technique, a catheter is placed through the abdominal wall into the gallbladder fundus.[71] The gallbladder can be drained and irrigated. A Foley or Malecot catheter or interventional radiology–type percutaneous drains have been used for this technique.[72]

SC

If the gallbladder can be visualized, but inflammation in the hepatocystic triangle is prohibitive, an SC is preferred. This operation, known in its open variant for over a century, has been successfully adapted to laparoscopy and is more popular as the culture of safety in LC gained traction. It can be performed in 2 variants: fenestrating and reconstituting cholecystectomy (**Figure 2**A).[73]

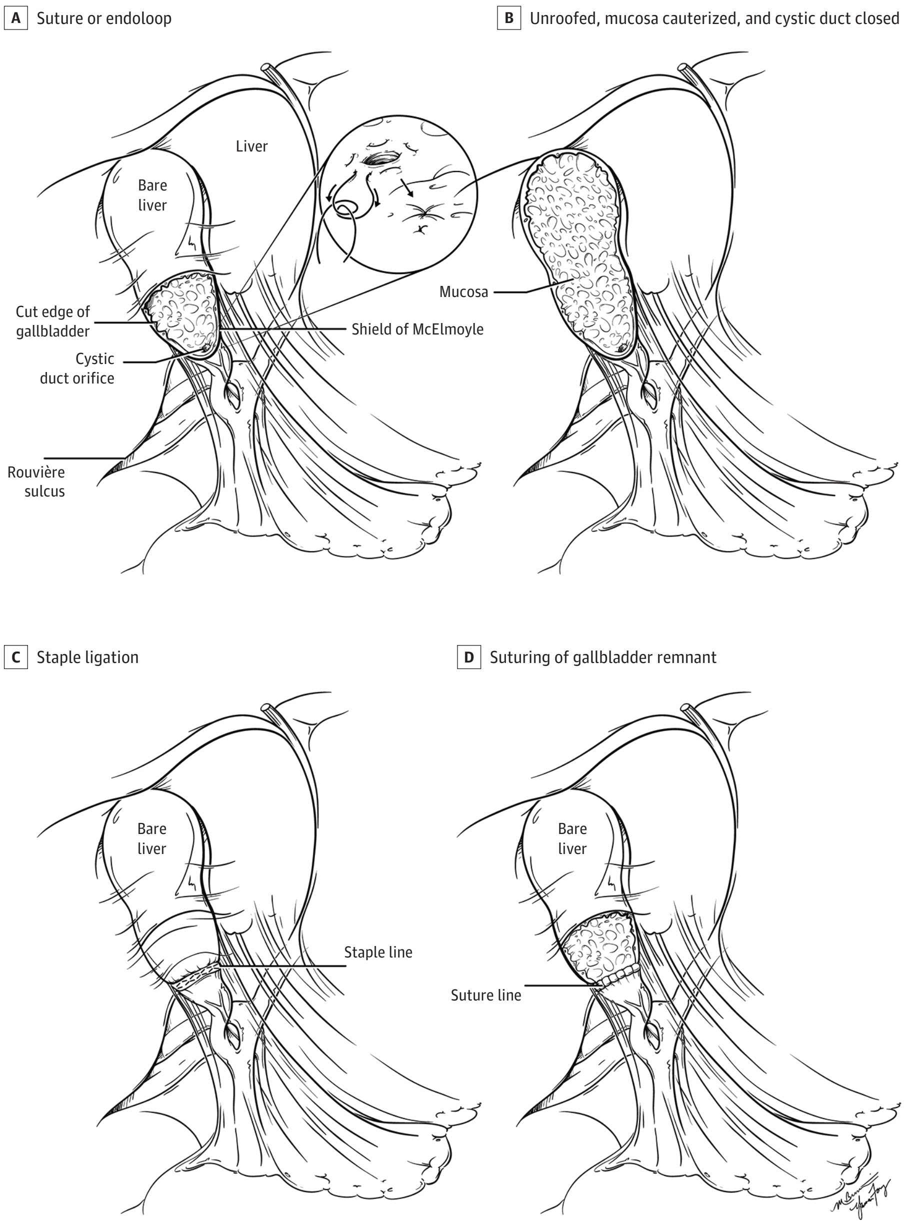
The fenestrating technique involves opening the gallbladder longitudinally, removing the stones, and dissecting the gallbladder off the cystic plate except for a short cuff near the hepatocystic triangle. The body of the gallbladder is then resected off the cuff. The cystic duct is usually left open, although closure with a suture or endoloop has been described (Figure 2A, insert). When removing the stone impacted in the infundibulum (Mirizzi syndrome), if there is bile reflux into the surgical field, closure of the cystic duct is preferred. A drain is usually left in the right-upper quadrant. In cases of severe bleeding from the cystic plate, the gallbladder wall adherent to the liver plate can be left in situ to minimize blood loss and the mucosa cauterized to sterilize the area and prevent a mucocele (Figure 2B). The Argon beam coagulator is an excellent instrument to cauterize the surface of the cystic plate or the remnant mucosa.

In the reconstituting technique, the gallbladder is dissected with a fundus-first (top-down) approach. The infundibulum is then stapled (Figure 2C), leaving a small infundibular pouch. Alternatively, the gallbladder can be transected with electrocautery, and the reconstitution can be performed by suturing the gallbladder cuff closed (Figure 2D). In both techniques, removing all stones from the peritoneal cavity is important as these can be sources of recurrent abscesses and fistulae, particularly if they travel in the subdiaphragmatic space. Strasberg and colleagues have favored the fenestrating technique due to the perceived lower risk of cholecystitis of the gallbladder remnant.[74] A meta-analysis, including 7 studies that enrolled 590 patients, found higher bile leak rates with the fenestrating technique (14.1% vs 9.1%; odds ratio, 2.47; $P = .007$),[75] and similar BDI rates, wound infections, reoperations, and need for completion cholecystectomy.

Anterograde (Top-Down) Cholecystectomy

The fundus-first (or anterograde/top-down) technique is a viable bailout. The operative steps are like an open cholecystectomy: the liver is retracted cranially (additional port or extra retractor may help) and dissection of the gallbladder starts at the fundus, proceeding toward the infundibulum. Cystic artery and cystic duct are isolated last, after the gallbladder is completely dissected off the fossa. The fundus-first approach is suggested by TG[76] and the Multi-Society Safe Cholecystectomy Guideline[61] as a possible alternative for difficult retrograde dissection. A study of more than 160 000 LCs demonstrated that the fundus-first approach had similar complication and BDI rates compared with the retrograde technique.[77]

Figure 2. Alternatives to Classic Cholecystectomy



If the anatomic area posterior to the plane of the sulcus is too inflamed for safe dissection, a top-down cholecystectomy can be considered. It can be taken down as far as it is safe and the gallbladder amputated. After stones are removed and the area irrigated, the cystic duct can be controlled from within the remnant gallbladder by suture or endoloop (A), by staple-ligation (C), or by suturing of the gallbladder remnant (D). Alternatively, the gallbladder can be unroofed, the mucosa cauterized, and the cystic duct closed (B).

Conversion to Open Surgery

Conversion to open surgery was traditionally considered a bailout for LC.[78] With increased laparoscopic experience and decreased indications for open cholecystectomy, there has been a shift in the operative experience of young surgeons. In 2023, US general surgery residents graduated with an average of 124 LCs and 6.6 open cholecystectomies.[79] Converting a difficult laparoscopic operation to an open procedure does not necessarily mean converting to an easier procedure. Consulting a senior partner with significant open hepatobiliary experience is recommended. Conversion is particularly desirable for bleeding that cannot be controlled laparoscopically and for suspected gallbladder malignancy. Challenging anatomical situations, like Mirizzi syndrome or cholecystoenteric fistulae, may also be tackled more easily in an open fashion, depending on surgeon and local hepatobiliary expertise. The inability to obtain CVS is not an indication for converting to open surgery unless one prefers to perform an SC in an open approach.

GBC Encountered Unexpectedly in the Operating Room

For intraluminal, single, sessile polyps, a total cholecystectomy should be performed, including cystic plate resection. This minimizes the risk of spillage of gallbladder contents and complete removal of the lymphatic tissue in the gallbladder (submuscularis layer). A frozen section should be obtained to diagnose and assess liver and cystic duct margins. If cancer is diagnosed and margins are negative, lymph node sampling should be performed for staging.

For larger gallbladder masses that are encountered unexpectedly in the operating room and suspected to be cancer, look for metastases. T4 GBCs almost always have peritoneal metastases. T3 or T4 cancers have a high incidence of nodal metastases. A verified perihepatic node that is cancer-positive allows for appropriate chemotherapy in a neoadjuvant setting before return for definitive operation. In absence of metastases, gallbladder mass biopsy should be made through liver parenchyma expected to be resected with definitive surgery and not by direct gallbladder punction to decrease tumor spillage risk. Intraoperative consultation with a hepatobiliary surgeon should be considered if immediate definitive procedure is contemplated.

Suspected BDI

There remains a finite BDI risk when performing cholecystectomies, particularly a DC. It is usually recognized intraoperatively as a bile leak. When noticing a bile leak, the key is to pause and not panic. If possible, seek help from a hepatobiliary surgeon. If experienced help is available and you recognize there is a CBD injury, then perhaps a primary repair is indicated. Most importantly, resist the temptation of wanting to repair the injury on your own and do not make it worse. The easiest bailout is to place good drains and return to fight another day.

If an accessory duct is leaking, consider ligating it with a simple tie or suture. If it only drains a small portion of the liver, subsequent repair may be unnecessary. Ligating it also allows the ducts in the affected liver to dilate and be evaluated for importance. Dilated ducts are also much easier to fix later if needed. Simple drainage is also a possible bailout.

Summary and Future Directions

The Society of American Gastrointestinal and Endoscopic Surgeons Safe Cholecystectomy Guidelines[80] recommend 6 steps to improving safety for DC: (1) CVS to identify the cystic duct and cystic artery, (2) evaluate for aberrant anatomy in all cases, (3) liberal use of cholangiography or other methods to image the biliary tree intraoperatively, (4) intraoperative momentary pause before clipping, cutting, or transecting ductal structures,(5) finish the operation safely with methods other than cholecystectomy when a zone of dissection is recognized to be too dangerous, and (6) intraoperative consultation with colleagues if operative progress is unattainable.

Our key points and recommendations for DC are summarized in the **Box**. There is no substitute for choosing the right time for surgery, armed with the optimal preoperative imaging to optimize patient outcomes. Probably in the future, artificial intelligence (AI) will help with triage per patient factors, presentation, and laboratory values for optimal scanning and surgery scheduling. Additionally, AI computer vision and augmented displays might help intraoperative conduct. Recently, AI models were trained with 290 LC videos from 37 countries and 153 surgeons. Using annotations from 4 high-volume surgeons, the AI model was trained to distinguish safe (go) and unsafe (no-go) dissection zones.[81]

Robotic technology is equipped to integrate with communication systems that can facilitate telementoring or even telesurgery. While the capabilities of telesurgery are limited to facilities equipped with a robotic platform, widespread adoption of mobile video communication makes remote video consultation possible even in developing countries or limited rural settings.[82]

Box. Ten Key Points and Recommendations for the Difficult Cholecystectomy

Difficult cholecystectomy is associated with longer operative times, higher blood loss, conversion to open surgery, and biliary and vascular injuries.

Factors that can contribute to a difficult cholecystectomy include obesity, male gender, elevated American Society of Anesthesiology score, aberrant anatomy, inability to achieve critical view of safety (CVS), and cirrhosis.

Early intervention (less than 72 hours) is recommended as opposed to delayed intervention. If preoperative optimization is required, it should be obtained during this time frame. Patients who are poor surgical candidates should be directed toward nonoperative management.

Appropriate preoperative planning is paramount for intraoperative success. Additional preoperative imaging may help delineate the anatomy. Adequate operating room setup can make a difficult cholecystectomy easier: choose a room capable of fluoroscopy, place a footboard, and have additional equipment available in the room (suction irrigator, bariatric trocars, retractors).

Access to the abdomen should be obtained with a familiar technique and away from expected intra-abdominal adhesions.

Identifying known anatomical landmarks (Rouvière sulcus, duodenum, bile duct) is important to avoid dissection in potentially dangerous areas. Frequent reorientation by backing the camera out periodically and moving the gallbladder back and forth (waving the flag) can help with keeping the dissection in the correct plane.

Intraoperative biliary imaging (intraoperative cholangiogram, laparoscopic ultrasound, indocyanine green) can be used to facilitate identification of biliary structures.

When the critical view of safety cannot be identified, it is advisable to perform an additional surgical time-out; calling a colleague for advice and surgical assistance is recommended. Perseverating in trying to achieve the CVS in difficult cases can cause severe biliary and vascular injuries.

Surgeons should be familiar with bailout procedures: tube cholecystostomy, subtotal cholecystectomy, top-down dissection, and conversion to open.

In the presence of a suspected bile duct injury, it is important to stop the operation, call for advice (either in person or via video-call), and resist the temptation to fix the injury and making it worse. Wide drainage is an appropriate temporizing strategy that does not jeopardize future permanent repair.

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REFERENCES

1. Flum DR, Dellinger EP, Cheadle A, Chan L, Koepsell T. Intraoperative cholangiography and risk of common bile duct injury during cholecystectomy. *JAMA*. 2003;289(13):1639-1644. doi:10.1001/jama.289.13.1639

2. Halbert C, Altieri MS, Yang J, et al. Long-term outcomes of patients with common bile duct injury following laparoscopic cholecystectomy. *Surg Endosc*. 2016;30(10):4294-4299. doi:10.1007/s00464-016-4745-9

3. Fong ZV, Pitt HA, Strasberg SM, et al; California Cholecystectomy Group. Diminished survival in patients with bile leak and ductal injury: management strategy and outcomes. *J Am Coll Surg*. 2018;226(4):568-576.e1. doi:10.1016/j.jamcollsurg.2017.12.023

4. Strasberg SM, Hertl M, Soper NJ. An analysis of the problem of biliary injury during laparoscopic cholecystectomy. *J Am Coll Surg*. 1995;180(1):101-125.

5. Nassar AHM, Ng HJ, Wysocki AP, Khan KS, Gil IC. Achieving the critical view of safety in the difficult laparoscopic cholecystectomy: a prospective study of predictors of failure. *Surg Endosc*. 2021;35(11):6039-6047. doi:10.1007/s00464-020-08093-3

6. Peitzman AB, Watson GA, Marsh JW. Acute cholecystitis: When to operate and how to do it safely. *J Trauma Acute Care Surg*. 2015;78(1):1-12. doi:10.1097/TA.0000000000000476

7. Seshadri A, Peitzman AB. The difficult cholecystectomy: What you need to know. *J Trauma Acute Care Surg*. 2024;97(3):325-336. doi:10.1097/TA.0000000000004337

8. Gregori M, Miccini M, Biacchi D, de Schoutheete JC, Bonomo L, Manzelli A. Day case laparoscopic cholecystectomy: safety and feasibility in obese patients. *Int J Surg*. 2018;49:22-26. doi:10.1016/j.ijsu.2017.11.051

9. Augustin T, Moslim MA, Brethauer S, et al. Obesity and its implications for morbidity and mortality after cholecystectomy: a matched NSQIP analysis. *Am J Surg*. 2017;213(3):539-543. doi:10.1016/j.amjsurg.2016.11.037

10. Nassar AHM, Hodson J, Ng HJ, et al; CholeS Study Group, West Midlands Research Collaborative. Predicting the difficult laparoscopic cholecystectomy: development and validation of a pre-operative risk score using an objective operative difficulty grading system. *Surg Endosc*. 2020;34(10):4549-4561. doi:10.1007/s00464-019-07244-5

11. Frazee RC, Roberts JW, Symmonds R, et al. What are the contraindications for laparoscopic cholecystectomy? *Am J Surg*. 1992;164(5):491-494. doi:10.1016/S0002-9610(05)81187-0

12. Hussain A. Difficult laparoscopic cholecystectomy: current evidence and strategies of management. *Surg Laparosc Endosc Percutan Tech*. 2011;21(4):211-217. doi:10.1097/SLE.0b013e318220f1b1

13. Tang B, Cuschieri A. Conversions during laparoscopic cholecystectomy: risk factors and effects on patient outcome. *J Gastrointest Surg*. 2006;10(7):1081-1091. doi:10.1016/j.gassur.2005.12.001

14. Pal A, Ahluwalia PS, Sachdeva K, Kashyap R. Intraoperative scoring system to assess the difficult laparoscopic cholecystectomy: a prospective study from a tertiary care centre. *Cureus*. 2023;15(3):e35767. doi:10.7759/cureus.35767

15. Puggioni A, Wong LL. A meta analysis of laparoscopic cholecystectomy in patients with cirrhosis. *J Am Coll Surg*. 2003;197(6):921-926. doi:10.1016/j.jamcollsurg.2003.08.011

16. Vreeland TJ, Balla FM, Lin E, Davis SS Jr, Yheulon CG. Post-operative outcomes for patients with liver-related ascites undergoing non-emergent laparoscopic cholecystectomy. *Surg Endosc*. 2021;35(2):884-890. doi:10.1007/s00464-020-07461-3

17. Strasberg SM. Clinical practice. Acute calculous cholecystitis. *N Engl J Med*. 2008;358(26):2804-2811. doi:10.1056/NEJMcp0800929

18. Yokoe M, Takada T, Strasberg SM, et al; Tokyo Guidelines Revision Committee. TG13 diagnostic criteria and severity grading of acute cholecystitis (with videos). *J Hepatobiliary Pancreat Sci*. 2013;20(1):35-46. doi:10.1007/s00534-012-0568-9

19. Yokoe M, Hata J, Takada T, et al. Tokyo Guidelines 2018: diagnostic criteria and severity grading of acute cholecystitis (with videos). *J Hepatobiliary Pancreat Sci*. 2018;25(1):41-54. doi:10.1002/jhbp.515

20. Mishima K, Fujiyama Y, Wakabayashi T, et al. Early laparoscopic cholecystectomy for acute cholecystitis following the Tokyo Guidelines 2018: a prospective single-center study of 201 consecutive cases. *Surg Endosc*. 2023;37(8):6051-6061. doi:10.1007/s00464-023-10094-x

21. Naito K, Suda K, Shinoda K, et al. Preoperative difficulty factors in delayed laparoscopic cholecystectomy: Tokyo Guidelines 2018 surgical difficulty score analysis. *Asian J Endosc Surg*. 2024;17(2):e13309. doi:10.1111/ases.13309

22. Chen G, Li M, Cao B, Xu Q, Zhang Z. Risk prediction models for difficult cholecystectomy. *Wideochir Inne Tech Maloinwazyjne*. 2022;17(2):303-308. doi:10.5114/wiitm.2022.114539

23. da Costa DW, Schepers NJ, Bouwense SA, et al; Dutch Pancreatitis Study Group. Predicting a 'difficult cholecystectomy' after mild gallstone pancreatitis. *HPB (Oxford)*. 2019;21(7):827-833. doi:10.1016/j.hpb.2018.10.015

24. Tan HY, Gong JF, Tang WH, Li P, Yang K. Risk assessment of laparoscopic cholecystectomy in liver cirrhotic patients with clinically significant portal hypertension: a retrospective cohort study. *J Laparoendosc Adv Surg Tech A*. 2019;29(9):1116-1121. doi:10.1089/lap.2019.0170

25. Kuhlenschmidt K, Taveras LR, Schuster KM, et al. A novel preoperative score to predict severe acute cholecystitis. *J Trauma Acute Care Surg*. 2024;96(6):870-875. doi:10.1097/TA.0000000000004308

26. Yoshida MC, Ogami T, Ho K, Bui EX, Khedr S, Chen CC. Patient and surgeon factors contributing to bailout cholecystectomies: a single-institutional retrospective analysis. *Surg Endosc*. 2022;36(9):6696-6704. doi:10.1007/s00464-021-08942-9

27. Di Buono G, Romano G, Galia M, et al. Difficult laparoscopic cholecystectomy and preoperative predictive factors. *Sci Rep*. 2021;11(1):2559. doi:10.1038/s41598-021-81938-6

28. Di Martino M, Mora-Guzmán I, Jodra VV, et al. How to predict postoperative complications after early laparoscopic cholecystectomy for acute cholecystitis: the chole-risk score. *J Gastrointest Surg*. 2021;25(11):2814-2822. doi:10.1007/s11605-021-04956-9

29. Sutcliffe RP, Hollyman M, Hodson J, Bonney G, Vohra RS, Griffiths EA; CholeS study group, West Midlands Research Collaborative. Preoperative risk factors for conversion from laparoscopic to open cholecystectomy: a validated risk score derived from a prospective UK database of 8820 patients. *HPB (Oxford)*. 2016;18(11):922-928. doi:10.1016/j.hpb.2016.07.015

30. Reddy S, Jagtap N, Kalapala R, et al. Choledocholithiasis in acute calculous cholecystitis: guidelines and beyond. *Ann Gastroenterol*. 2021;34(2):247-252. doi:10.20524/aog.2020.0562

31. Guo X, Fan Q, Guo Y, et al. Clinical study on the necessity and feasibility of routine MRCP in patients with cholecystolithiasis before LC. *BMC Gastroenterol*. 2024;24(1):28. doi:10.1186/s12876-023-03117-3

32. Mattila A, Pynnönen E, Sironen A, et al. Routine preoperative MRCP in screening choledocholithiasis in acute cholecystitis compared to selective approach: a population-based study. *Updates Surg*. 2023;75(3):563-570. doi:10.1007/s13304-022-01390-7

33. Omiya K, Hiramatsu K, Shibata Y, et al. Preoperative magnetic resonance cholangiopancreatography for detecting difficult laparoscopic cholecystectomy in acute cholecystitis. *Diagnostics (Basel)*. 2021;11(3):383. doi:10.3390/diagnostics11030383

34. Kohga A, Suzuki K, Okumura T, et al. Does preoperative MRCP imaging predict risk for conversion to subtotal cholecystectomy in patients with acute cholecystitis? *Surg Endosc*. 2021;35(12):6717-6723. doi:10.1007/s00464-020-08175-2

35. Butte JM, Matsuo K, Gönen M, et al. Gallbladder cancer: differences in presentation, surgical treatment, and survival in patients treated at centers in three countries. *J Am Coll Surg*. 2011;212(1):50-61. doi:10.1016/j.jamcollsurg.2010.09.009

36. Ito H, Hann LE, D'Angelica M, et al. Polypoid lesions of the gallbladder: diagnosis and follow up. *J Am Coll Surg*. 2009;208(4):570-575. doi:10.1016/j.jamcollsurg.2009.01.011

37. Hawkins WG, DeMatteo RP, Jarnagin WR, Ben-Porat L, Blumgart LH, Fong Y. Jaundice predicts advanced disease and early mortality in patients with gallbladder cancer. *Ann Surg Oncol*. 2004;11(3):310-315. doi:10.1245/ASO.2004.03.011

38. Mayumi T, Okamoto K, Takada T, et al. Tokyo Guidelines 2018: management bundles for acute cholangitis and cholecystitis. *J Hepatobiliary Pancreat Sci*. 2018;25(1):96-100. doi:10.1002/jhbp.519

39. Mori Y, Itoi T, Baron TH, et al. Tokyo Guidelines 2018: management strategies for gallbladder drainage in patients with acute cholecystitis (with videos). *J Hepatobiliary Pancreat Sci*. 2018;25(1):87-95. doi:10.1002/jhbp.504

40. Teoh AYB, Kitano M, Itoi T, et al. Endosonography-guided gallbladder drainage versus percutaneous cholecystostomy in very high-risk surgical patients with acute cholecystitis: an international randomised multicentre controlled superiority trial (DRAC 1). *Gut*. 2020;69(6):1085-1091. doi:10.1136/gutjnl-2019-319996

41. Hemerly MC, de Moura DTH, do Monte Junior ES, et al. Endoscopic ultrasound (EUS)-guided cholecystostomy versus percutaneous cholecystostomy (PTC) in the management of acute

cholecystitis in patients unfit for surgery: a systematic review and meta-analysis. *Surg Endosc*. 2023;37(4):2421-2438. doi:10.1007/s00464-022-09712-x

42. Cucchetti A, Binda C, Dajti E, Sbrancia M, Ercolani G, Fabbri C. Trial sequential analysis of EUS-guided gallbladder drainage versus percutaneous cholecystostomy in patients with acute cholecystitis. *Gastrointest Endosc*. 2022;95(3):399-406. doi:10.1016/j.gie.2021.09.028

43. de Mestral C, Rotstein OD, Laupacis A, et al. Comparative operative outcomes of early and delayed cholecystectomy for acute cholecystitis: a population-based propensity score analysis. *Ann Surg*. 2014;259(1):10-15. doi:10.1097/SLA.0b013e3182a5cf36

44. Gutt CN, Encke J, Köninger J, et al. Acute cholecystitis: early versus delayed cholecystectomy, a multicenter randomized trial (ACDC study, NCT00447304). *Ann Surg*. 2013;258(3):385-393. doi:10.1097/SLA.0b013e3182a1599b

45. Pisano M, Allievi N, Gurusamy K, et al. 2020 World Society of Emergency Surgery updated guidelines for the diagnosis and treatment of acute calculus cholecystitis. *World J Emerg Surg*. 2020;15(1):61. doi:10.1186/s13017-020-00336-x

46. Okamoto K, Suzuki K, Takada T, et al. Tokyo Guidelines 2018: flowchart for the management of acute cholecystitis. *J Hepatobiliary Pancreat Sci*. 2018;25(1):55-72. doi:10.1002/jhbp.516

47. Sicklick JK, Camp MS, Lillemoe KD, et al. Surgical management of bile duct injuries sustained during laparoscopic cholecystectomy: perioperative results in 200 patients. *Ann Surg*. 2005;241(5):786-792. doi:10.1097/01.sla.0000161029.27410.71

48. Sasmal PK, Tantia O, Jain M, Khanna S, Sen B. Primary access-related complications in laparoscopic cholecystectomy via the closed technique: experience of a single surgical team over more than 15 years. *Surg Endosc*. 2009;23(11):2407-2415. doi:10.1007/s00464-009-0437-z

49. Halpern NB. Access problems in laparoscopic cholecystectomy: postoperative adhesions, obesity, and liver disorders. *Semin Laparosc Surg*. 1998;5(2):92-106. doi:10.1177/155335069800500204

50. Larciprete G, Valli E, Meloni P, et al. Ultrasound detection of the "sliding viscera" sign promotes safer laparoscopy. *J Minim Invasive Gynecol*. 2009;16(4):445-449. doi:10.1016/j.jmig.2009.03.023

51. Kalata S, Thumma JR, Norton EC, Dimick JB, Sheetz KH. Comparative safety of robotic-assisted vs laparoscopic cholecystectomy. *JAMA Surg*. 2023;158(12):1303-1310. doi:10.1001/jamasurg.2023.4389

52. Shen A, Barmparas G, Melo N, et al. Incorporating robotic cholecystectomy in an acute care surgery practice model is feasible. *Am Surg*. 2024;90(10):2457-2462. doi:10.1177/00031348241248816

53. Lunardi N, Abou-Zamzam A, Florecki KL, et al. Robotic technology in emergency general surgery cases in the era of minimally invasive surgery. *JAMA Surg*. 2024;159(5):493-499. doi:10.1001/jamasurg.2024.0016

54. Magge D, Steve J, Novak S, et al. Performing the difficult cholecystectomy using combined endoscopic and robotic techniques: how I do it. *J Gastrointest Surg*. 2017;21(3):583-589. doi:10.1007/s11605-016-3323-8

55. Sohn HJ, Lee M, Han Y, et al. Clinical outcomes of minimally invasive (laparoscopic and robotic) versus open extended cholecystectomy: a multicenter propensity score matched study. *J Hepatobiliary Pancreat Sci*. Published online February 7, 2024. doi:10.1002/jhbp.1419

56. Cho YJ, Yun WG, Jung HS, et al. Oncologic safety of robotic extended cholecystectomy for gallbladder cancer. *Surg Endosc*. 2023;37(12):9089-9097. doi:10.1007/s00464-023-10463-6

57. Madni TD, Leshikar DE, Minshall CT, et al. The Parkland grading scale for cholecystitis. *Am J Surg*. 2018;215(4):625-630. doi:10.1016/j.amjsurg.2017.05.017

58. Schuster KM, O'Connor R, Cripps M, et al. Revision of the AAST grading scale for acute cholecystitis with comparison to physiologic measures of severity. *J Trauma Acute Care Surg*. 2022;92(4):664-674. doi:10.1097/TA.0000000000003507

59. Griffiths EA, Hodson J, Vohra RS, et al; CholeS Study Group; West Midlands Research Collaborative. Utilisation of an operative difficulty grading scale for laparoscopic cholecystectomy. *Surg Endosc*. 2019;33(1):110-121. doi:10.1007/s00464-018-6281-2

60. Schendel J, Ball C, Dixon E, Sutherland F. Prevalence of anatomic landmarks for orientation during elective laparoscopic cholecystectomies. *Surg Endosc*. 2020;34(8):3508-3512. doi:10.1007/s00464-019-07131-z

61. Brunt LM, Deziel DJ, Telem DA, et al; Prevention of Bile Duct Injury Consensus Work Group. Safe cholecystectomy multi-society practice guideline and state-of-the-art consensus conference on prevention of bile duct injury during cholecystectomy. *Surg Endosc*. 2020;34(7):2827-2855. doi:10.1007/s00464-020-07568-7

62. Biffl WL, Moore EE, Offner PJ, Franciose RJ, Burch JM. Routine intraoperative laparoscopic ultrasonography with selective cholangiography reduces bile duct complications during laparoscopic cholecystectomy. *J Am Coll Surg*. 2001;193(3):272-280. doi:10.1016/S1072-7515(01)00991-7

63. Hall C, Amatya S, Shanmugasundaram R, Lau NS, Beenen E, Gananadha S. Intraoperative cholangiography in laparoscopic cholecystectomy: a systematic review and meta-analysis. *JSLS*. 2023;27(1):e2022.00093. doi:10.4293/JSLS.2022.00093

64. van den Bos J, Schols RM, Boni L, et al. Near-infrared fluorescence cholangiography assisted laparoscopic cholecystectomy (FALCON): an international multicentre randomized controlled trial. *Surg Endosc*. 2023;37(6):4574-4584. doi:10.1007/s00464-023-09935-6

65. Lim SH, Tan HTA, Shelat VG. Comparison of indocyanine green dye fluorescent cholangiography with intra-operative cholangiography in laparoscopic cholecystectomy: a meta-analysis. *Surg Endosc*. 2021;35(4):1511-1520. doi:10.1007/s00464-020-08164-5

66. Dip F, Lo Menzo E, White KP, Rosenthal RJ. Does near-infrared fluorescent cholangiography with indocyanine green reduce bile duct injuries and conversions to open surgery during laparoscopic or robotic cholecystectomy?—a meta-analysis. *Surgery*. 2021;169(4):859-867. doi:10.1016/j.surg.2020.12.008

67. Manatakis DK, Antonopoulou MI, Tasis N, et al. Critical view of safety in laparoscopic cholecystectomy: a systematic review of current evidence and future perspectives. *World J Surg*. 2023;47(3):640-648. doi:10.1007/s00268-022-06842-0

68. McELMOYLE WA. Cholecystectomy: a method for the difficult gall-bladder. *Lancet*. 1954;266(6826):1320-1323. doi:10.1016/S0140-6736(54)92210-2

69. Gupta V, Jain G. Safe laparoscopic cholecystectomy: adoption of universal culture of safety in cholecystectomy. *World J Gastrointest Surg*. 2019;11(2):62-84. doi:10.4240/wjgs.v11.i2.62

70. Strasberg SM. A three-step conceptual roadmap for avoiding bile duct injury in laparoscopic cholecystectomy: an invited perspective review. *J Hepatobiliary Pancreat Sci*. 2019;26(4):123-127. doi:10.1002/jhbp.616

71. Haicken BN. Laparoscopic tube cholecystostomy. *Surg Endosc*. 1992;6(6):285-288. doi:10.1007/BF02498861

72. Bradley KM, Dempsey DT. Laparoscopic tube cholecystostomy: still useful in the management of complicated acute cholecystitis. *J Laparoendosc Adv Surg Tech A*. 2002;12(3):187-191. doi:10.1089/10926420260188083

73. Strasberg SM, Pucci MJ, Brunt LM, Deziel DJ. Subtotal cholecystectomy-"fenestrating" vs "reconstituting" subtypes and the prevention of bile duct injury: definition of the optimal procedure in difficult operative conditions. *J Am Coll Surg*. 2016;222(1):89-96. doi:10.1016/j.jamcollsurg.2015.09.019

74. LeCompte MT, Robbins KJ, Williams GA, et al. Less is more in the difficult gallbladder: recent evolution of subtotal cholecystectomy in a single HPB unit. *Surg Endosc*. 2021;35(7):3249-3257. doi:10.1007/s00464-020-07759-2

75. Hajibandeh S, Hajibandeh S, Parente A, et al. Meta-analysis of fenestrating versus reconstituting subtotal cholecystectomy in the management of difficult gallbladder. *HPB (Oxford)*. 2024;26(1):8-20. doi:10.1016/j.hpb.2023.09.005

76. Wakabayashi G, Iwashita Y, Hibi T, et al. Tokyo Guidelines 2018: surgical management of acute cholecystitis: safe steps in laparoscopic cholecystectomy for acute cholecystitis (with videos). *J Hepatobiliary Pancreat Sci*. 2018;25(1):73-86. doi:10.1002/jhbp.517

77. Edergren Å, Sandblom G, Franko M, Agustsson T, Cengiz Y, Jaafar G. Safety of cholecystectomy performed by surgeons who prefer fundus first versus surgeons who prefer a standard laparoscopic approach. *Surg Open Sci*. 2024;19:141-145. doi:10.1016/j.sopen.2024.04.004

78. Southern Surgeons C; Southern Surgeons Club. A prospective analysis of 1518 laparoscopic cholecystectomies. *N Engl J Med*. 1991;324(16):1073-1078. doi:10.1056/NEJM199104183241601

79. Strasberg SM, Gouma DJ. 'Extreme' vasculobiliary injuries: association with fundus-down cholecystectomy in severely inflamed gallbladders. *HPB (Oxford)*. 2012;14(1):1-8. doi:10.1111/j.1477-2574.2011.00393.x

80. SAGES. The SAGES Safe Cholecystectomy Program. Accessed September 9, 2025. https://www.sages.org/safe-cholecystectomy-program/

81. Madani A, Namazi B, Altieri MS, et al. Artificial intelligence for intraoperative guidance: using semantic segmentation to identify surgical anatomy during laparoscopic cholecystectomy. *Ann Surg*. 2022;276(2):363-369. doi:10.1097/SLA.0000000000004594

82. Laudari U, Pradhan R, Shrestha D, Bhandari S, Thapa PB. Feasibility of telementoring as an intraoperative time-out tool during laparoscopic cholecystectomy for prevention of biliovascular injuries. *J Nepal Health Res Counc*. 2023;20(3):816-819. doi:10.33314/jnhrc.v20i3.4015