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Review Article

Current Management of Acute Calculus Cholecystitis: Review Article

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Abstract: The management of acute calculus cholecystitis has seen a change in management with the introduction of early laparoscopic cholecystectomy. The management of high-risk patients or Tokyo Guideline grade 3, however, is an area of concern. Drainage of the gallbladder is a bridging procedure that is performed to stabilize patients to perform an interval cholecystectomy later. Percutaneous cholecystostomy is the most common drainage procedure, with endoscopic procedures like Endoscopic trans papillary gallbladder drainage and Endoscopic Ultrasound Gallbladder drainage being reserved for patients who will not undergo surgery. In this review, we will investigate the role of early laparoscopic cholecystectomy, subtotal cholecystectomy, and drainage of the gallbladder in the management of acute cholecystitis.

Keywords: Acute calculus cholecystitis, Delayed laparoscopic cholecystectomy, early laparoscopic cholecystectomy, endoscopic drainage, Gallbladder drainage, percutaneous cholecystostomy, and subtotal cholecystectomy.

INTRODUCTION

Acute calculus cholecystitis is characterized by localized gallbladder inflammation that occurs due to the obstruction of the cystic duct. The incidence of acute cholecystitis is unknown, but it is predominantly seen in female patients rather than male patients. The diagnosis of acute cholecystitis is made from a combination of clinical examination, blood investigations, and imaging modalities. Blood investigations include leukocytosis, and the most common imaging modality is ultrasound of the gallbladder. The management of acute cholecystitis includes conservative treatment with intravenous antibiotics and cholecystectomy(Bagla *et al*., 2016; Halpin, 2013). The surgical management of acute calculus cholecystitis involves performing a laparoscopic cholecystectomy, with early laparoscopic cholecystectomy being performed from twenty-four hours to seven days from the onset of symptoms. Delayed laparoscopic cholecystectomy is performed after eight weeks from the onset of symptoms(Koti *et al*., 2015).

The Tokyo Guidelines of 2013 and 2018 have divided acute cholecystitis into three categories: Grade 1, which is mild acute cholecystitis, characterized by symptoms of biliary colic; Grade 2, which is moderate acute cholecystitis, characterized by symptoms of biliary colic, positive Murphy's sign, pyrexia, and leukocytosis. Grade 3 or severe acute cholecystitis, which is characterized by clinical symptoms of acute cholecystitis with either cardiovascular, respiratory, renal, hematological, or neurological dysfunction. The management for Grade 1 is elective cholecystectomy, Grade 2 is early cholecystectomy, and Grade 3 is by performing a gallbladder drainage procedure, like percutaneous cholecystostomy, and performing an interval cholecystectomy later(Gomi *et al*., 2018; Okamoto *et al*., 2018; Yokoe *et al*., 2013, 2018).

The World Society of Emergency Surgery (WSES) in their updated guidelines for the diagnosis and treatment of acute calculus cholecystitis has recommended laparoscopic cholecystectomy as the treatment of choice for acute calculus cholecystitis. They have also recommended that early laparoscopic cholecystectomy be performed within seven days from admission or ten days from the onset of symptoms. Delayed laparoscopic cholecystectomy can be performed after six weeks from the onset of symptoms. For high-risk surgical patients who are not fit for a cholecystectomy, drainage of the gallbladder with a percutaneous cholecystostomy is recommended to

stabilize the patient and perform an interval cholecystectomy later. Endoscopic gallbladder drainage procedures have also been recommended if the expertise is available(Campanile *et al*., 2014; Pisano *et al*., 2020).

The management of acute calculus cholecystitis has seen a trend toward early laparoscopic cholecystectomy. For high-risk surgical patients with acute cholecystitis, drainage of the gallbladder is encouraged, and once the patient is stabilized, an interval laparoscopic cholecystectomy is performed. The choice of gallbladder drainage procedure includes a percutaneous or endoscopic procedure. We have conducted this review article to investigate the various management options. We conducted a literature review using PUBMED, Cochrane database of clinical reviews, and Google Scholar, looking for clinical trials, observational studies, cohort studies, systematic reviews, and meta-analyses from 1990 to 2025. We used the following keywords: "Acute calculus cholecystitis", "early laparoscopic cholecystectomy", "delayed laparoscopic cholecystectomy", "percutaneous cholecystostomy "," endoscopic drainage, "gallbladder drainage", and "subtotal cholecystectomy". All articles were in the English language only. Further articles were obtained by manually cross-referencing the literature. Case reports and studies with fewer than 10 patients and editorials were excluded. Adult male and female patients were included in this study; pregnant patients and pediatric patients were excluded.

DISCUSSION

Early Laparoscopic Cholecystectomy

Early laparoscopic cholecystectomy is defined as performing surgery from twenty-four hours to seven days from the onset of symptoms of acute cholecystitis. The Tokyo guidelines have recommended that the decision to perform early laparoscopic cholecystectomy should be based on the patient's clinical condition, co-morbidity, and the severity grading of acute cholecystitis(Bundgaard *et al*., 2021; Kao *et al*., 2018). Early laparoscopic cholecystectomy was associated with shorter hospital stay, quicker recovery, and reduced cost. However, there is no difference regarding morbidity and mortality(Blohm *et al*., 2017; Yamashita *et al*., 2013).

Siddiqui *et al*. conducted a meta-analysis of randomized controlled trials comparing early versus delayed laparoscopic cholecystectomy for acute cholecystitis. Four studies with 375 patients were included in this study. Early laparoscopic cholecystectomy was associated with reduced hospital stay but prolonged operative time. There were no differences regarding conversion to open cholecystectomy and post-operative morbidity(Siddiqui *et al*., 2008). A similar meta-analysis of randomized controlled trials comparing early versus delayed laparoscopic cholecystectomy by Shikata *et al* also arrived at the same conclusion(Shikata *et al*., 2005).

Gurusamy *et al*. conducted a meta-analysis of randomized controlled trials on the safety and effectiveness of early versus delayed laparoscopic cholecystectomy for acute cholecystitis. Five trials with 451 patients were included in this study, and early laparoscopic cholecystectomy was associated with reduced hospital stay, and it was found to be safe and effective in the management of acute cholecystitis(Gurusamy *et al*., 2010).Another meta-analysis comparing early versus delayed laparoscopic cholecystectomy for acute cholecystitis by Wu *et al*, Lau *et al*, Zhou *et al*, and Lyu *et al* also concluded that early laparoscopic cholecystectomy was safe and effective in the management of acute cholecystitis(Lau *et al*., 2006; Lyu *et al*., 2018; Wu *et al*., 2015; Zhou *et al*., 2014).

A prospective randomized clinical trial on the management of acute cholecystitis was conducted by Johansson *et al*. One hundred and forty-five patients were randomized to seventy-four who underwent early laparoscopic cholecystectomy and seventy-one who underwent delayed laparoscopic cholecystectomy. Early laparoscopic cholecystectomy was associated with a higher conversion rate, but reduced hospital stays and cost(Johansson *et al*., 2003.).Another prospective randomized study comparing early versus delayed laparoscopic cholecystectomy by Ozkardes *et al*, also concluded that early laparoscopic cholecystectomy was associated with reduced hospital stay and better outcomes(Özkardeş *et al*., 2014).

Table Ⅰ: Table showing the bile duct injury and conversion rate from early laparoscopic cholecystectomy for acute cholecystitis

Study	Study type	N=numbers	Year	Bile duct injury (Odds Ratio)	Conversion to open surgery (relative risk)
Siddiqui *et al.,*	Meta-analysis	375	2008	0.68	0.92
Gurusamy *et al.,*	Meta-analysis	488	2013	0.49	0.89
Zhou *et al.,*	Meta-analysis	1106	2014	0.49	0.91

Conversion to Total or Subtotal Cholecystectomy

The conversion rate from laparoscopic to open cholecystectomy for acute cholecystitis is 11% to 31%. Some of the factors that affect the conversion to open cholecystectomy include the age of the patient, the presence of co-morbidities like diabetes mellitus, elevated levels of total white cell count, and serum bilirubin. The Tokyo Grading for patients with acute cholecystitis is an important factor, as patients in grade three are at a higher risk of conversion from laparoscopic to open cholecystectomy (Bouassida *et al*., 2017).Male patients are at a higher risk of conversion from

laparoscopic to open cholecystectomy due to a longer duration of symptoms of acute cholecystitis and the presence of a higher incidence of adhesions during surgery(Yajima *et al*., 2014).

A systematic review and meta-analysis of observational studies on preoperative risk factors for conversion of laparoscopic cholecystectomy to open surgery was conducted by Rothman *et al*. Ten studies with 25,778 patients were included in this study, and they concluded that male gender, age above 65 years, the presence of acute cholecystitis with thickness of the gallbladder of greater than 5mm were risk factors for conversion to open cholecystectomy(Philip Rothman *et al*., 2016).A systematic review on the preoperative and intraoperative risk factors for the conversion of laparoscopic to open cholecystectomy was conducted by Chin *et al*. This study concluded that increased age, male sex, prolonged symptoms of acute cholecystitis of more than seventy-two hours, obesity, and elevated C-reactive protein are factors that can lead to conversion from a laparoscopic to open cholecystectomy(Chin *et al*., 2023).

Subtotal cholecystectomy is considered a bailout or rescue procedure for patients with severe inflammation at the Calot's triangle, where further dissection will lead to a risk of injury to the common bile duct or hepatic ducts. There are two methods of performing a subtotal cholecystectomy: a type A, where the stump is left open, and a type B, where the stump is closed. Toro *et al*. performed a systematic review on how to finalize a laparoscopic subtotal cholecystectomy. A total of six hundred and seventy-eight patients were included in this study, and those patients who had undergone closure of the gallbladder stump were associated with the least number of complications(Toro *et al*., 2021). Another systematic review on laparoscopic subtotal cholecystectomy for difficult gallbladder was conducted by Al-Azzawi *et al,* and they concluded that subtotal cholecystectomy was a viable alternative operation for a difficult gallbladder(Al-Azzawi *et al*., 2024).

A systematic review and meta-analysis comparing subtotal versus total cholecystectomy for acute cholecystitis was conducted by Koo *et al*. Ten studies with 1911 patients were included in this study. Subtotal cholecystectomy was associated with a reduced risk of common bile duct injury but an increased risk of bile leak, intra-abdominal collection, and reoperation rate. This study concluded that subtotal cholecystectomy is a viable alternative when there is severe inflammation(Koo *et al*., 2024). Another systematic review and meta-analysis on subtotal cholecystectomy for difficult gallbladder, which was conducted by Eishaer *et al*, also concluded that subtotal cholecystectomy is an important procedure that can be used in difficult gallbladder to achieve the least number of complications and risk of common bile duct injury(Elshaer *et al*., 2015).

Gallbladder Drainage for Acute Cholecystitis

The Tokyo Guidelines have recommended gallbladder drainage for patients who present with grade three acute cholecystitis. Percutaneous gallbladder drainage or percutaneous cholecystostomy is the most common procedure, followed by endoscopic drainage procedures, which include Endoscopic trans papillary gallbladder drainage and Endoscopic Ultrasound-guided gallbladder drainage. These procedures are done as a bridging procedure to stabilize these high-risk patients and perform an interval cholecystectomy later (Mori *et al*., 2018; Tsuyuguchi *et al*., 2007)

Percutaneous Cholecystostomy

This is the most common drainage procedure that is performed for high-risk patients with acute cholecystitis or those in Grade 3 of the Tokyo Guidelines. This is an interventional procedure that is performed by the radiologist and involves puncturing and draining the gallbladder. It can be performed by a trans-hepatic or trans-peritoneal approach. The trans-hepatic approach is the most common as it is associated with reduced complications. The most common complications include bleeding, perforation of the bowel, peritonitis, dislodgement of the tube, and recurrent cholecystitis(Corbetta Machado *et al*., 2020; Gandhi *et al*., 2020; Gulaya *et al*., 2016; Horn *et al*., 2015; Kesim & Özen, 2023; Sanjay *et al*., 2013).

Percutaneous cholecystostomy was compared to emergency cholecystectomy in a systematic review and meta-analysis by Cirocchi *et al*. Seventeen studies with 783,672 patients were included in this study. Percutaneous cholecystostomy was associated with an increased mortality, readmission rate, and length of hospital stay when compared with emergency cholecystectomy(Cirocchi *et al*., 2023).Another meta-analysis by Huang *et al* comparing percutaneous cholecystostomy with emergency cholecystectomy for acute cholecystitis in high-risk patients also concluded that emergency cholecystectomy is superior to percutaneous cholecystostomy in the management of acute cholecystitis in high-risk patients(Huang *et al*., 2022).

The laparoscopic cholecystectomy versus percutaneous catheter drainage for acute cholecystitis in high-risk patients (CHOCOLATE) multicenter randomized clinical trial was conducted by Loozen *et al*. One hundred and forty-two patients were randomized to sixty-six who underwent percutaneous drainage and sixty-eight who underwent laparoscopic cholecystectomy. There was no difference in mortality between the two procedures, but percutaneous cholecystostomy was associated with higher complications (65% vs 12%) and reintervention (66% vs 12%). This clinical trial concluded that laparoscopic cholecystectomy was associated with reduced major complications when compared to percutaneous cholecystostomy(Loozen *et al*., 2018).

Endoscopic Drainage of the Gallbladder for Acute Cholecystitis

Endoscopic drainage of the gallbladder is another drainage procedure that is performed endoscopically. There are two methods, Endoscopic Trans papillary Gallbladder Drainage and Endoscopic Ultrasound Guided Gallbladder Drainage. Both procedures are indicated for high-risk surgical patients who will not undergo a cholecystectomy. Both endoscopic procedures are highly technical and require advanced endoscopic training. The most common complications from these procedures include bleeding, perforation of the stomach or duodenum, and peritonitis(Chan & Teoh, 2018; Hasan *et al*., 2013; Higa & Irani, 2019; Manudhane *et al*., 2024; Mori *et al*., 2018; Tsuyuguchi *et al*., 2007)

Endoscopic Trans papillary Gallbladder Drainage is performed via an endoscopic retrograde cholangiopancreatography, and after the cannulation of the common bile duct, the cystic duct is then cannulated, and a catheter is introduced into the gallbladder proximally and distally through the ampulla into the second part of the duodenum. The technical success of this procedure is between 65% to 100%, depending on the center(Ali *et al*., 2023; Sobani *et al*., 2021; Suzuki *et al*., 2024).A meta-analysis on the efficacy and safety of endoscopic trans papillary gallbladder drainage in acute cholecystitis was conducted by Jandura *et al*. Twenty-one studies with 1307 patients were included in this study. The clinical success rate was 94.87%, and the technical success rate was 82.62%. This study showed the efficacy and safety of endoscopic trans papillary gallbladder drainage(Jandura & Puli, 2021).

Endoscopic Ultrasound Guided Gallbladder Drainage is another endoscopic procedure where the gallbladder is punctured via the stomach or duodenum, and a stent is inserted to facilitate drainage of the gallbladder. The stents that are used include plastic or metallic, with the lumen approximation metallic stents being the current preferred choice of stent. The complications include bleeding, perforation of the stomach or duodenum, and stent migration(Choi & Lee, 2015; Crinò *et al*., 2019; Irani *et al*., 2023; Ishii *et al*., 2023; Lisotti *et al*., 2022).

Endoscopic Ultrasound-guided Gallbladder Drainage was compared with Endoscopic Trans papillary Gallbladder Drainage in high-risk patients with acute cholecystitis in a systematic review and meta-analysis by Krishnamoorthi *et al*. Five studies with 857 patients were included in this study. There was no difference regarding the clinical and technical success rates between the two procedures. Endoscopic ultrasound gallbladder drainage was associated with a slight reduction in recurrence rate. This study showed that Endoscopic Ultrasound Guided Gallbladder Drainage is now the most common endoscopic drainage procedure for acute cholecystitis in high-risk patients(Krishnamoorthi *et al*., 2020).

CONCLUSION

Laparoscopic cholecystectomy is the treatment of choice for acute cholecystitis, with early laparoscopic cholecystectomy being indicated for patients with Grade 2 Tokyo Guidelines. Early laparoscopic cholecystectomy is usually performed during the index admission for acute cholecystitis. Delayed laparoscopic cholecystectomy is performed after eight weeks from the onset of acute cholecystitis. Subtotal cholecystectomy is a bailout procedure for cases where a laparoscopic cholecystectomy cannot be performed due to adhesions at Calot's triangle.

Gallbladder drainage is a useful procedure to treat high-risk patients with acute cholecystitis. Percutaneous cholecystostomy is the most common procedure due to the ease with which this procedure can be performed. The management of the tube and recurrent cholecystitis are some of the problems with this procedure. Endoscopic gallbladder drainage is now being offered in high-risk patients who will never undergo a cholecystectomy, but this procedure requires advanced endoscopic equipment and training.

Conflict of Interest: There is no conflict of interest.

REFERENCES

- Al-Azzawi, M., Abouelazayem, M., Parmar, C., Singhal, R., Amr, B., Martinino, A., Atıcı, S. D., & Mahawar, K. (2024). A systematic review on laparoscopic subtotal cholecystectomy for difficult gallbladders: a lifesaving bailout or an incomplete operation? In *Annals of the Royal College of Surgeons of England* (Vol. 106, Issue 3, pp. 205–212). https://doi.org/10.1308/rcsann.2023.0008
- Ali, H., Shamoon, S., Bolick, N. L., Manickam, S., Sattar, U., Poola, S., & Mudireddy, P. (2023). Outcomes of endoscopic retrograde cholangiopancreatography-guided gallbladder drainage compared to percutaneous cholecystostomy in acute cholecystitis. *Annals of Hepato-Biliary-Pancreatic Surgery*, *27*(1), 56–62. https://doi.org/10.14701/ahbps.22-065
- Bagla, P., Sarria, J. C., & Riall, T. S. (2016). Management of acute cholecystitis. In *Current Opinion in Infectious Diseases* (Vol. 29, Issue 5, pp. 508–513). Lippincott Williams and Wilkins. https://doi.org/10.1097/QCO.0000000000000297
- Blohm, M., Österberg, J., Sandblom, G., Lundell, L., Hedberg, M., & Enochsson, L. (2017). The Sooner, the Better? The Importance of Optimal Timing of Cholecystectomy in Acute Cholecystitis: Data from the National Swedish Registry for Gallstone Surgery, GallRiks. *Journal of Gastrointestinal Surgery*, *21*(1), 33–40. https://doi.org/10.1007/s11605-016-3223-y
- Bouassida, M., Chtourou, M. F., Charrada, H., Zribi, S., Hamzaoui, L., Mighri, M. M., & Touinsi, H. (2017). The severity grading of acute cholecystitis

following the Tokyo Guidelines is the most powerful predictive factor for conversion from laparoscopic cholecystectomy to open cholecystectomy. *Journal of Visceral Surgery*, *154*(4), 239–243. https://doi.org/10.1016/j.jviscsurg.2016.11.007

- Bundgaard, N. S., Bohm, A., Hansted, A. K., & Skovsen, A. P. (2021). Early laparoscopic cholecystectomy for acute cholecystitis is safe regardless of timing. *Langenbeck's Archives of Surgery*, *406*(7), 2367–2373. https://doi.org/10.1007/s00423-021-02229-2
- Campanile, F. C., Pisano, M., Coccolini, F., Catena, F., Agresta, F., & Ansaloni, L. (2014). Acute cholecystitis: WSES position statement. In *World Journal of Emergency Surgery* (Vol. 9, Issue 1). BioMed Central Ltd. https://doi.org/10.1186/1749-7922-9-58
- Chan, J. H. Y., & Teoh, A. Y. B. (2018). Current status of endoscopic gallbladder drainage. In *Clinical Endoscopy* (Vol. 51, Issue 2, pp. 150–155). Korean Society of Gastrointestinal Endoscopy. https://doi.org/10.5946/ce.2017.125
- Chin, X., Mallika Arachchige, S., Orbell-Smith, J., & Wysocki, A. P. (2023). Preoperative and Intraoperative Risk Factors for Conversion of Laparoscopic Cholecystectomy to Open Cholecystectomy: A Systematic Review of 30 Studies. *Cureus*. https://doi.org/10.7759/cureus.47774
- Choi, J. H., & Lee, S. S. (2015). Endoscopic ultrasonography-guided gallbladder drainage for acute cholecystitis: From evidence to practice. In *Digestive Endoscopy* (Vol. 27, Issue 1, pp. 1–7). Blackwell Publishing. https://doi.org/10.1111/den.12386
- Cirocchi, R., Amato, L., Ungania, S., Buononato, M., Tebala, G. D., Cirillo, B., Avenia, S., Cozza, V., Costa, G., Davies, R. J., Sapienza, P., Coccolini, F., Mingoli, A., Chiarugi, M., & Brachini, G. (2023). Management of Acute Cholecystitis in High-Risk Patients: Percutaneous Gallbladder Drainage as a Definitive Treatment vs. Emergency Cholecystectomy—Systematic Review and Meta-Analysis. In *Journal of Clinical Medicine* (Vol. 12, Issue 15). Multidisciplinary Digital Publishing Institute (MDPI). https://doi.org/10.3390/jcm12154903
- Corbetta Machado, M. J., Gray, A., Cerdeira, M. P., & Gani, J. (2020). Short- and long-term outcomes of percutaneous cholecystostomy in an Australian population. *ANZ Journal of Surgery*, *90*(9), 1660–1665. https://doi.org/10.1111/ans.15726
- Crinò, S. F., Rimbaș, M., Gabbrielli, A., & Larghi, A. (2019). Endoscopic ultrasound guided gallbladder interventions: A review of the current literature. In *Journal of Gastrointestinal and Liver Diseases* (Vol. 28, Issue 3, pp. 339–347). Romanian Society of Gastroenterology. https://doi.org/10.15403/jgld-215
- Elshaer, M., Gravante, G., Thomas, K., Sorge, R., Al-Hamali, S., & Ebdewi, H. (2015). Subtotal cholecystectomy for "Difficult gallbladders": Systematic review and meta-analysis. *JAMA Surgery*, *150*(2), 159–168. https://doi.org/10.1001/jamasurg.2014.1219
- Gandhi, K., Du Plessis, R., Klopper, J., & Kloppers, C. (2020). Percutaneous Cholecystostomy Placement in Cases of Non-operative Cholecystitis: A Retrospective Cohort Analysis. *World Journal of Surgery*, *44*(12), 4077–4085. https://doi.org/10.1007/s00268-020-05752-3
- Gomi, H., Solomkin, J. S., Schlossberg, D., Okamoto, K., Takada, T., Strasberg, S. M., Ukai, T., Endo, I., Iwashita, Y., Hibi, T., Pitt, H. A., Matsunaga, N., Takamori, Y., Umezawa, A., Asai, K., Suzuki, K., Han, H. S., Hwang, T. L., Mori, Y., … Yamamoto, M. (2018). Tokyo Guidelines 2018: antimicrobial therapy for acute cholangitis and cholecystitis. *Journal of Hepato-Biliary-Pancreatic Sciences*, *25*(1), 3–16. https://doi.org/10.1002/jhbp.518
- Gulaya, K., Desai, S. S., & Sato, K. (2016). Percutaneous cholecystostomy: Evidence-based current clinical practice. *Seminars in Interventional Radiology*, *33*(4), 291–296. https://doi.org/10.1055/s-0036-1592326
- Gurusamy, K., Samraj, K., Gluud, C., Wilson, E., & Davidson, B. R. (2010). Meta-analysis of randomized controlled trials on the safety and effectiveness of early versus delayed laparoscopic cholecystectomy for acute cholecystitis. *British Journal of Surgery*, *97*(2), 141–150. https://doi.org/10.1002/bjs.6870
- Halpin V. (2014). Acute cholecystitis. *BMJ clinical evidence*, *2014*, 0411.
- Hasan, M. K., Itoi, T., & Varadarajulu, S. (2013). Endoscopic Management of Acute Cholecystitis. In *Gastrointestinal Endoscopy Clinics of North America* (Vol. 23, Issue 2, pp. 453–459). https://doi.org/10.1016/j.giec.2012.12.010
- Higa, J. T., & Irani, S. S. (2019). Endoscopic Methods for Gallbladder Drainage. *Current Treatment Options in Gastroenterology*, *17*(3), 357–366. https://doi.org/10.1007/s11938-019-00243-4
- Horn, T., Christensen, S. D., Kirkegård, J., Larsen, L. P., Knudsen, A. R., & Mortensen, F. V. (2015). Percutaneous cholecystostomy is an effective treatment option for acute calculous cholecystitis: A 10-year experience. *HPB*, *17*(4), 326–331. https://doi.org/10.1111/hpb.12360
- Huang, H., Zhang, H., Yang, D., Wang, W., & Zhang, X. (2022). Percutaneous cholecystostomy versus emergency cholecystectomy for the treatment of acute calculous cholecystitis in high-risk surgical patients: a meta-analysis and systematic review. In *Updates in Surgery* (Vol. 74, Issue 1, pp. 55–64). Springer Science and Business Media Deutschland GmbH. https://doi.org/10.1007/s13304-021-01081-9
- Irani, S. S., Sharma, N. R., Storm, A. C., Shah, R. J., Chahal, P., Willingham, F. F., Swanstrom, L., Baron, T. H., Shlomovitz, E., Kozarek, R. A., Peetermans, J. A., McMullen, E., Ho, E., & Van Der Merwe, S. W. (2023). Endoscopic Ultrasound-

guided Transluminal Gallbladder Drainage in Patients with Acute Cholecystitis: A Prospective Multicenter Trial. *Annals of Surgery*, *278*(3), E556–E562. https://doi.org/10.1097/SLA.0000000000005784

- Ishii, K., Fujita, Y., Suzuki, E., Koyama, Y., Tsujino, S., Nagao, A., Hosono, K., Teratani, T., Kubota, K., & Nakajima, A. (2023). The Efficacy and Safety of EUS-Guided Gallbladder Drainage as a Bridge to Surgery for Patients with Acute Cholecystitis. *Journal of Clinical Medicine*, *12*(8). https://doi.org/10.3390/jcm12082778
- Jandura, D. M., & Puli, S. R. (2021). Efficacy and safety of endoscopic transpapillary gallbladder drainage in acute cholecystitis: An updated meta-analysis. *World Journal of Gastrointestinal Endoscopy*, *13*(8), 345–355. https://doi.org/10.4253/wjge.v13.i8.345
- Johansson, M., Thune, A., Blomqvist, A., Nelvin, L., & Lundell, L. (2003). Management of acute cholecystitis in the laparoscopic era: results of a prospective, randomized clinical trial. *Journal of gastrointestinal surgery: official journal of the Society for Surgery of the Alimentary Tract*, *7*(5), 642–645. https://doi.org/10.1016/s1091-255x(03)00065-9
- Kao, L. S., Ball, C. G., & Chaudhury, P. K. (2018). Evidence-based reviews in surgery: Early cholecystectomy for cholecystitis. *Annals of Surgery*, *268*(6), 940–942. https://doi.org/10.1097/SLA.0000000000002867
- Kesim, Ç., & Özen, Ö. (2023). Ultrasound-guided percutaneous cholecystostomy as bridging or definitive treatment in patients with acute cholecystitis grade II or III. *Heliyon*, *9*(5). https://doi.org/10.1016/j.heliyon.2023.e15601
- Koo, S. S., Krishnan, R. J., Ishikawa, K., Matsunaga, M., Ahn, H. J., Murayama, K. M., & Kitamura, R. K. (2024). Subtotal vs total cholecystectomy for difficult gallbladders: A systematic review and meta-analysis. *American Journal of Surgery*, *229*, 145–150. https://doi.org/10.1016/j.amjsurg.2023.12.022
- Koti, R. S., Davidson, C. J., & Davidson, B. R. (2015). Surgical management of acute cholecystitis. *Langenbeck's Archives of Surgery*, *400*(4), 403–419. https://doi.org/10.1007/s00423-015-1306-y
- Krishnamoorthi, R., Jayaraj, M., Thoguluva Chandrasekar, V., Singh, D., Law, J., Larsen, M., Ross, A., Kozarek, R., & Irani, S. (2020). EUS-guided versus endoscopic transpapillary gallbladder drainage in high-risk surgical patients with acute cholecystitis: a systematic review and meta-analysis. In *Surgical Endoscopy* (Vol. 34, Issue 5, pp. 1904–1913). Springer. https://doi.org/10.1007/s00464-020-07409-7
- Lau, H., Lo, C. Y., Patil, N. G., & Yuen, W. K. (2006). Early versus delayed-interval laparoscopic cholecystectomy for acute cholecystitis: A metaanalysis. In *Surgical Endoscopy and Other Interventional Techniques* (Vol. 20, Issue 1, pp. 82–87). https://doi.org/10.1007/s00464-005-0100-2
- Lisotti, A., Linguerri, R., Bacchilega, I., Cominardi, A., Marocchi, G., & Fusaroli, P. (2022). EUS-guided gallbladder drainage in high-risk surgical patients with acute cholecystitis—procedure outcomes and evaluation of mortality predictors. *Surgical Endoscopy*, *36*(1), 569–578. https://doi.org/10.1007/s00464-021-08318-z
- Loozen, C. S., Van Santvoort, H. C., Van Duijvendijk, P., Besselink, M. G., Gouma, D. J., Nieuwenhuijzen, G. A., Kelder, J. C., Donkervoort, S. C., Van Geloven, A. A., Kruyt, P. M., Roos, D., Kortram, K., Kornmann, V. N., Pronk, A., Van Der Peet, D. L., Crolla, R. M., Van Ramshorst, B., Bollen, T. L., & Boerma, D. (2018). Laparoscopic cholecystectomy versus percutaneous catheter drainage for acute cholecystitis in high risk patients (CHOCOLATE): Multicentre randomised clinical trial. *BMJ (Online)*, *363*. https://doi.org/10.1136/bmj.k3965
- Lyu, Y., Cheng, Y., Wang, B., Zhao, S., & Chen, L. (2018). Early versus delayed laparoscopic cholecystectomy for acute cholecystitis: an up-to-date meta-analysis of randomized controlled trials. In *Surgical Endoscopy* (Vol. 32, Issue 12, pp. 4728–4741). Springer New York LLC. https://doi.org/10.1007/s00464-018-6400-0
- Manudhane, A. P., Leupold, M. D., Shah, H. W., Shah, R., Han, S. Y., Lee, P. J., Burlen, J. J., Papachristou, G. I., & Krishna, S. G. (2024). A Review on Endoscopic Management of Acute Cholecystitis: Endoscopic Ultrasound-Guided Gallbladder Drainage and Endoscopic Transpapillary Gallbladder Drainage. In *Medicina (Lithuania)* (Vol. 60, Issue 2). Multidisciplinary Digital Publishing Institute (MDPI). https://doi.org/10.3390/medicina60020212
- Mori, Y., Itoi, T., Baron, T. H., Takada, T., Strasberg, S. M., Pitt, H. A., Ukai, T., Shikata, S., Noguchi, Y., Teoh, A. Y. B., Kim, M. H., Asbun, H. J., Endo, I., Yokoe, M., Miura, F., Okamoto, K., Suzuki, K., Umezawa, A., Iwashita, Y., … Yamamoto, M. (2018). Tokyo Guidelines 2018: management strategies for gallbladder drainage in patients with acute cholecystitis (with videos). *Journal of Hepato-Biliary-Pancreatic Sciences*, *25*(1), 87–95. https://doi.org/10.1002/jhbp.504
- Okamoto, K., Suzuki, K., Takada, T., Strasberg, S. M., Asbun, H. J., Endo, I., Iwashita, Y., Hibi, T., Pitt, H. A., Umezawa, A., Asai, K., Han, H. S., Hwang, T. L., Mori, Y., Yoon, Y. S., Huang, W. S. W., Belli, G., Dervenis, C., Yokoe, M., … Yamamoto, M. (2018). Tokyo Guidelines 2018: flowchart for the management of acute cholecystitis. *Journal of Hepato-Biliary-Pancreatic Sciences*, *25*(1), 55–72. https://doi.org/10.1002/jhbp.516
- Özkardeş, A. B., Tokaç, M., Dumlu, E. G., Bozkurt, B., Çiftçi, A. B., Yetişir, F., & Kiliç, M. (2014). Early versus delayed laparoscopic cholecystectomy for acute cholecystitis: A prospective, randomized

study. *International Surgery*, *99*(1), 56–61. https://doi.org/10.9738/INTSURG-D-13-00068.1

- Philip Rothman, J., Burcharth, J., Pommergaard, H. C., Viereck, S., & Rosenberg, J. (2016). Preoperative Risk Factors for Conversion of Laparoscopic Cholecystectomy to Open Surgery-A Systematic Review and Meta-Analysis of Observational Studies. In *Digestive Surgery* (Vol. 33, Issue 5, pp. 414–423). S. Karger AG. https://doi.org/10.1159/000445505
- Pisano, M., Allievi, N., Gurusamy, K., Borzellino, G., Cimbanassi, S., Boerna, D., Coccolini, F., Tufo, A., Di Martino, M., Leung, J., Sartelli, M., Ceresoli, M., Maier, R. V., Poiasina, E., De Angelis, N., Magnone, S., Fugazzola, P., Paolillo, C., Coimbra, R., … Ansaloni, L. (2020). 2020 World Society of Emergency Surgery updated guidelines for the diagnosis and treatment of acute calculus cholecystitis. In *World Journal of Emergency Surgery* (Vol. 15, Issue 1). BioMed Central Ltd. https://doi.org/10.1186/s13017-020-00336-x
- Sanjay, P., Mittapalli, D., Marioud, A., White, R. D., Ram, R., & Alijani, A. (2013). Clinical outcomes of a percutaneous cholecystostomy for acute cholecystitis: A multicentre analysis. *HPB*, *15*(7), 511–516. https://doi.org/10.1111/j.1477-2574.2012.00610.x
- Shikata, S., Noguchi, Y., & Fukui, T. (2005). Early versus delayed cholecystectomy for acute cholecystitis: A meta-analysis of randomized controlled trials. *Surgery Today*, *35*(7), 553–560. https://doi.org/10.1007/s00595-005-2998-3
- Siddiqui, T., MacDonald, A., Chong, P. S., & Jenkins, J. T. (2008). Early versus delayed laparoscopic cholecystectomy for acute cholecystitis: a meta-analysis of randomized clinical trials. *American Journal of Surgery*, *195*(1), 40–47. https://doi.org/10.1016/j.amjsurg.2007.03.004
- Sobani, Z. A., Ling, C., & Rustagi, T. (2021). Endoscopic Transpapillary Gallbladder Drainage for Acute Cholecystitis. In *Digestive Diseases and Sciences* (Vol. 66, Issue 5, pp. 1425–1435). Springer. https://doi.org/10.1007/s10620-020-06422-z
- Suzuki, K., Naito, H., Naito, E., Sasaki, T., Yoshikawa, Y., Omagari, K., Yoshitake, N., Koike, T., Hashimoto, T., & Tamura, A. (2024). Evaluation of the Validity of Endoscopic Transpapillary Gallbladder Drainage for Acute Cholecystitis Based on the Tokyo Guidelines 2018. *Journal of Clinical Gastroenterology*, *58*(4), 419–425. https://doi.org/10.1097/MCG.0000000000001866
- Toro, A., Teodoro, M., Khan, M., Schembari, E., Di Saverio, S., Catena, F., & Di Carlo, I. (2021). Subtotal cholecystectomy for difficult acute cholecystitis: how to finalize safely by laparoscopy—a systematic review. In *World Journal of Emergency Surgery* (Vol. 16, Issue 1). BioMed Central Ltd. https://doi.org/10.1186/s13017-021-00392-x
- Tsuyuguchi, T., Takada, T., Kawarada, Y., Nimura, Y., Wada, K., Nagino, M., Mayumi, T., Yoshida, M., Miura, F., Tanaka, A., Yamashita, Y., Hirota, M., Hirata, K., Yasuda, H., Kimura, Y., Neuhaus, H., Strasberg, S., Pitt, H., Belghiti, J., … Dervenis, C. (2007). Techniques of biliary drainage for acute cholecystitis: Tokyo Guidelines. *Journal of Hepato-Biliary-Pancreatic Surgery*, *14*(1), 46–51. https://doi.org/10.1007/s00534-006-1155-8
- Wu, X. D., Tian, X., Liu, M. M., Wu, L., Zhao, S., & Zhao, L. (2015). Meta-analysis comparing early versus delayed laparoscopic cholecystectomy for acute cholecystitis. In *British Journal of Surgery* (Vol. 102, Issue 11, pp. 1302–1313). John Wiley and Sons Ltd. https://doi.org/10.1002/bjs.9886
- Yajima, H., Kanai, H., Son, K., Yoshida, K., & Yanaga, K. (2014). Reasons and risk factors for intraoperative conversion from laparoscopic to open cholecystectomy. *Surgery Today*, *44*(1), 80–83. https://doi.org/10.1007/s00595-012-0465-5
- Yamashita, Y., Takada, T., Strasberg, S. M., Pitt, H. A., Gouma, D. J., Garden, O. J., Büchler, M. W., Gomi, H., Dervenis, C., Windsor, J. A., Kim, S. W., De Santibanes, E., Padbury, R., Chen, X. P., Chan, A. C. W., Fan, S. T., Jagannath, P., Mayumi, T., Yoshida, M., … Supe, A. N. (2013). TG13 surgical management of acute cholecystitis. *Journal of Hepato-Biliary-Pancreatic Sciences*, *20*(1), 89–96. https://doi.org/10.1007/s00534-012-0567-x
- Yokoe, M., Hata, J., Takada, T., Strasberg, S. M., Asbun, H. J., Wakabayashi, G., Kozaka, K., Endo, I., Deziel, D. J., Miura, F., Okamoto, K., Hwang, T. L., Huang, W. S. W., Ker, C. G., Chen, M. F., Han, H. S., Yoon, Y. S., Choi, I. S., Yoon, D. S., … Yamamoto, M. (2018). Tokyo Guidelines 2018: diagnostic criteria and severity grading of acute cholecystitis (with videos). *Journal of Hepato-Biliary-Pancreatic Sciences*, *25*(1), 41–54. https://doi.org/10.1002/jhbp.515
- Yokoe, M., Takada, T., Strasberg, S. M., Solomkin, J. S., Mayumi, T., Gomi, H., Pitt, H. A., Garden, O. J., Kiriyama, S., Hata, J., Gabata, T., Yoshida, M., Miura, F., Okamoto, K., Tsuyuguchi, T., Itoi, T., Yamashita, Y., Dervenis, C., Chan, A. C. W., … Ker, C. G. (2013). TG13 diagnostic criteria and severity grading of acute cholecystitis (with videos). *Journal of Hepato-Biliary-Pancreatic Sciences*, *20*(1), 35–46. https://doi.org/10.1007/s00534-012-0568-9
- Zhou, M. W., Gu, X. D., Xiang, J. Bin, & Chen, Z. Y. (2014). Comparison of clinical safety and outcomes of early versus delayed laparoscopic cholecystectomy for acute cholecystitis: A meta-analysis. In *Scientific World Journal* (Vol. 2014). Hindawi Publishing Corporation. https://doi.org/10.1155/2014/274516