



Narrative Review on Complicated Cholecystitis: An Update on Management

Kumar H.R^{+++*}

^a *Taylors University School of Medicine and Health Science, 47500 Selangor, Malaysia.*

Author's contribution

The sole author designed, analysed, interpreted and prepared the manuscript.

Article Information

DOI: <https://doi.org/10.9734/ajmah/2024/v22i81074>

Open Peer Review History:

This journal follows the Advanced Open Peer Review policy. Identity of the Reviewers, Editor(s) and additional Reviewers, peer review comments, different versions of the manuscript, comments of the editors, etc are available here: <https://www.sdiarticle5.com/review-history/120446>

Review Article

Received: 18/05/2024
Accepted: 22/07/2024
Published: 25/07/2024

ABSTRACT

Complicated cholecystitis is a term used to describe the local complications that occur in acute cholecystitis. It included gangrenous, empyema and perforation of the gallbladder. The diagnosis of these conditions involves clinical, laboratory investigations and imaging modalities. The treatment of complicated cholecystitis is by performing a cholecystectomy, either by an open or laparoscopic method. Laparoscopic cholecystectomy is associated with a high conversion rate due to inflammation of the gallbladder which makes dissection difficult. Subtotal cholecystectomy is an alternative surgical procedure in patients who have adhesions at the calot's triangle. We have conducted this review article to look at the types of complicated cholecystitis, and the diagnosis and treatment of these conditions.

Keywords: *Complicated cholecystitis; gangrenous cholecystitis; emphysematous cholecystitis; empyema of gallbladder; perforation of gallbladder.*

⁺⁺ Associate Professor of Surgery;

^{*}Corresponding author: E-mail: kharirajah@yahoo.com.my;

Cite as: H.R, Kumar. 2024. "Narrative Review on Complicated Cholecystitis: An Update on Management". *Asian Journal of Medicine and Health* 22 (8):98-105. <https://doi.org/10.9734/ajmah/2024/v22i81074>.

1. INTRODUCTION

Acute calculus cholecystitis is one of the most common complications of gallstone disease and it accounts for 20% of patients who present with symptomatic gallstone disease. It has a higher incidence in female patients with an overall incidence of 18.8% in females and 9.5% in males [1].

The Tokyo Guidelines have classified the severity of acute cholecystitis into three grade, Grade 1 is mild acute cholecystitis with no organ dysfunction, Grade 2 is moderate acute cholecystitis which is characterized by elevated white sell count, Palpable tender mass over the right hypochondrium, duration of symptoms of more than 72 hours and marked local inflammation like gangrenous or emphysematous cholecystitis. Grade 3 is characterized by acute cholecystitis that is associated with any of the following organ dysfunction cardiovascular, respiratory, neurological, renal, hepatic or hematological [2–5].

The progression of the acute inflammatory changes that occur in acute cholecystitis can lead to a few local complications of the gallbladder like gangrenous cholecystitis which is characterized by necrosis of the gallbladder wall, and it is the most common complication of acute cholecystitis. Emphysematous cholecystitis is due to intramural proliferation of gas-forming

organisms like clostridium. Empyema of the gallbladder which is associated with purulent material in the gallbladder and perforation of the gallbladder which is usually seen in the fundus [6].

The grading of acute cholecystitis according to severity is important as it can help to assess which patients will benefit from performing an early laparoscopic cholecystectomy and those that may benefit from optimization and performing a delayed cholecystectomy. Complicated cholecystitis is the term used to describe gangrenous, emphysematous, empyema and perforation of the gallbladder which occurs in cases of acute cholecystitis. The early diagnosis and treatment of these conditions is important as it is associated with high morbidity and mortality [7–10].

As there is no current consensus in the diagnosis and management of complicated acute cholecystitis regarding the treatment according to the Tokyo Guidelines, the definition of complicated cholecystitis and the management of this condition. We conducted a literature review using PUBMED, the Cochrane database of systemic reviews, Google scholar and Semantic Scholar looking for randomized control trials, non-randomized trials, observational and cohort studies, clinical reviews, systemic reviews, and meta-analysis from 1990 to 2024. The following

Table 1. The Tokyo Guidelines for severity grading for acute cholecystitis

Severity	Criteria
Grade 1-Mild	Acute cholecystitis with mild inflammation and no organ dysfunction
Grade 2-Moderate	Acute cholecystitis with any of the following features 1- like duration of symptoms above 72hrs, 2- leukocytosis, 3- mass over the right hypochondrium 4- Marked local inflammation like pericholecystic fluid collection.
Grade 3-severe	Acute cholecystitis with any of the following organ dysfunction 1-Cardiovascular dysfunction-hypotension 2-Neurological dysfunction-altered consciousness 3-Respiratory dysfunction-tachypnea 4-Renal dysfunction-oliguria 5-Hepatic dysfunction

Table 2. The management of acute cholecystitis according to the Tokyo guidelines

Tokyo Grade	Management
Grade 1	Early cholecystectomy
Grade 2	Early cholecystectomy
Grade 3	Percutaneous cholecystostomy followed by interval cholecystectomy

keywords were used, "complicated cholecystitis", "Gangrenous cholecystitis", "emphysematous cholecystitis", "empyema of gallbladder" and "perforation of gallbladder". All articles were in English, and all articles were assessed by manual cross referencing of the literature. Commentaries, case reports and editorials were excluded from this review. Adult male and female patients were included in this study. Pediatric and pregnant patients with complicated acute cholecystitis were excluded.

2. DISCUSSION

2.1 Gangrenous Cholecystitis

This is a serious complication of acute cholecystitis that occurs due to vascular insufficiency that leads to gangrene of the gallbladder. It is seen in up to 18% of patients who present with acute cholecystitis, and it is associated with a mortality of up to 50%. This condition is seen in patients with co-morbidities like diabetes mellitus and in older patients [11,12]. Gangrenous cholecystitis is diagnosed by a combination of clinical, laboratory and imaging modalities like ultrasound of the abdomen. Male patients are more prone to develop this condition and the presence of leukocytosis and C. Reactive protein values that are more than 100 are usually suggestive of this condition [13–16]. Imaging modalities that can aid in the diagnosis of gangrenous cholecystitis include ultrasonography which can demonstrate sloughed mucosal membrane, focal wall bulge, ulceration and disruption. Computerized tomography can be used in some patients where it may demonstrate irregular mural and wall enhancement, other findings on computerized tomography include irregular or absent wall, pericholecystic abscess and lack of gallbladder wall enhancement [17,18].

The mortality of gangrenous cholecystitis increases in patients with medical conditions like coronary artery disease, elevated serum bilirubin and the presence of systemic inflammatory response syndrome [19,20]. Delayed presentation of the patient to the hospital with an increase in the time from the onset of presentation and subsequent treatment can increase the mortality of gangrenous cholecystitis [21].

The treatment of acute gangrenous cholecystitis is by performing a cholecystectomy without delay. The introduction of laparoscopic

cholecystectomy has seen a shift in trend from open cholecystectomy towards laparoscopic cholecystectomy. The advantages of laparoscopic cholecystectomy include its minimally invasive nature, reduced morbidity and length of hospital stay. There is a risk of conversion to open cholecystectomy due to problems that may be encountered during dissection but with time and better practice, the conversion rate will come down [22,23].

2.2 Empyema of the Gallbladder

Empyema of the gallbladder is a complication of acute cholecystitis which is characterized by superinfection and suppuration of the stagnant bile in the gallbladder due to obstruction of the cystic duct. The lumen of the gallbladder is then filled with pus and mucopurulent material. It is a severe form of acute cholecystitis and is seen in 10%-15% of cases [24,25].

The diagnosis of empyema of the gallbladder is confirmed by ultrasonography which can demonstrate thickening of the gallbladder wall, distended gallbladder wall, pericholecystic fluid and echogenic material in the lumen of the gallbladder. Computerized tomography findings of empyema of the gallbladder are often indistinguishable from acute cholecystitis [26,27].

The treatment of empyema of the gallbladder involves resuscitation with fluids and starting intravenous antibiotics. A cholecystectomy should be performed as early as possible to prevent complications like sepsis and multi-organ failure. The best time to perform it is within 72 hours from admission to the hospital. Traditionally an open cholecystectomy was performed for empyema of the gallbladder, but laparoscopic cholecystectomy is now being performed due to its minimally invasive nature, reduced morbidity, mortality and length of hospital stay. The conversion rate is slightly high due to the distension of the gallbladder, gross inflammation at the calots triangle and adhesions over the gallbladder [28–32].

2.3 Perforation of the Gallbladder

This is a rare complication of acute cholecystitis which carries a mortality rate of 12% to 42%. Gallbladder perforation was classified by Niemeier into three types, type one was perforation into the free peritoneal cavity, type 2 was subacute perforation with abscess formation

Table 3. The types of gallbladder perforation according to the Niemeier classification

Type	explanation
One	Perforation of the gallbladder into the peritoneal cavity and it is not surrounded by any protective adhesions.
Two	Perforated gallbladder surrounded by an abscess that is walled off by adhesions
Three	The formation of a fistula between the perforated gallbladder with other viscera

and type 3 was perforation with fistula formation between the gallbladder and adjacent viscera. This classification is useful in the management of this condition [33,34]. Due to the high risk of mortality from gallbladder perforation, early diagnosis and treatment of this condition is important to prevent this. Empirical antibiotics and monitoring the patient in a high-dependency unit is important [35,36].

Gallbladder perforation is seen in 2% to 12% of patients who present with acute cholecystitis and the risk factors for perforation include delay in diagnosis, a delay in seeking treatment of more than 72 hours, male sex and age of more than 60 years. Patients who present with severe forms of inflammation are at risk of gallbladder perforation [37,38]. The management of perforation is by performing a cholecystectomy, and laparoscopic cholecystectomy is increasingly being used due to its minimally invasive nature, early recovery and reduced post-operative complications. Some have suggested that emergency cholecystectomy is indicated for Type 1 and 3 perforations and Type 2 perforation is managed with percutaneous cholecystostomy [39,40].

Several studies were conducted to look at the outcomes of perforation of the gallbladder and these studies concluded that early diagnosis and treatment of this condition is essential. Cholecystectomy should not be delayed, and laparoscopic cholecystectomy can be attempted but there is a high conversion rate. These patients were managed in the hospital for a longer period to manage their co-morbidities and they required prolonged intravenous antibiotics [41–45].

2.4 Subtotal Cholecystectomy for Complicated Cholecystitis

Subtotal cholecystectomy is a well-recognized option when a total cholecystectomy is not possible due to dense inflammation at the calot's triangle and the possibility of injury to the common bile duct is high. In this procedure, a portion of the gallbladder is left behind [46]. It can be performed as an open or laparoscopic

procedure, the gallbladder is incised, and the contents are aspirated, and the anterior wall is removed while leaving the posterior wall intact, closure of the gallbladder stump with either sutures or staplers and a drain is inserted. In some cases of severe inflammation, the stump is left open, but this can lead to persistent bile leak. The most common complication is bile leak and abscess formation [47]. Several studies have shown that laparoscopic subtotal cholecystectomy is a feasible and safe procedure, and it can be used for the management of complicated cholecystitis. The use of hemostatic instruments like the Harmonic scalpel will help in the dissection of the gallbladder. The stump can be sutured with an endo loop or hemlock can be applied [48].

3. CONCLUSION

Complicated cholecystitis is seen in about 15% of cases of acute cholecystitis but its diagnosis and treatment are a challenge to the general surgeon. The diagnosis of this condition is often delayed and performing a cholecystectomy is difficult due to the inflammation and adhesion around the gallbladder and calot's triangle. The conversion rate is high as most general surgeons will encounter difficulty when dissecting the calots triangle. The post-operative management is also prolonged as antibiotic coverage is prolonged and the use of drains will hinder the movement of the patient. The stay in the hospital will also be prolonged.

The management of complicated cholecystitis should involve consultation with senior members of the surgical team, the diagnosis and time of surgery should not be delayed and if there are no laparoscopic surgical services, then open cholecystectomy should be performed as early as possible to prevent complications like sepsis.

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Author(s) hereby declares that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc.) and text-to-image generators have been used during writing or editing of manuscripts.

CONSENT AND ETHICAL APPROVAL

It is not applicable.

COMPETING INTERESTS

Author has declared that no competing interests exist.

REFERENCES

1. Pisano M, Allievi N, Gurusamy K, Borzellino G, Cimbanassi S, Boerna D, et al. World Society of Emergency Surgery updated guidelines for the diagnosis and treatment of acute calculus cholecystitis. *World J Emerg Surg.* 2020 Nov 5;15(1): 61. DOI:10.1186/s13017-020-00336-x. PMID: 33153472; PMCID: PMC7643471.
2. Yokoe M, Takada T, Strasberg SM, Solomkin JS, Mayumi T, Gomi H, et al. Tokyo Guidelines revision committee. TG13 diagnostic criteria and severity grading of acute cholecystitis (with videos). *J Hepatobiliary Pancreat Sci.* 2013 Jan;20(1):35-46. DOI:10.1007/s00534-012-0568-9. PMID: 23340953.
3. Okamoto K, Suzuki K, Takada T, Strasberg SM, Asbun HJ, Endo I, et al. Tokyo guidelines 2018: Flowchart for the management of acute cholecystitis. *J Hepatobiliary Pancreat Sci;* 2018 Jan;25(1):55-72. DOI: 10.1002/jhbp.516. Epub 2017 Dec 20. Erratum in: *J Hepatobiliary Pancreat Sci.* 2019 Nov;26(11):534. DOI: 10.1002/jhbp.686. PMID: 29045062.
4. Gomi H, Solomkin JS, Schlossberg D, Okamoto K, Takada T, Strasberg SM, et al. Tokyo Guidelines 2018: antimicrobial therapy for acute cholangitis and cholecystitis. *J Hepatobiliary Pancreat Sci.* 2018 Jan 1;25(1):3–16. Available: <https://doi.org/10.1002/jhbp.518>
5. Yokoe M, Hata J, Takada T, Strasberg SM, Asbun HJ, Wakabayashi G, et al. Tokyo Guidelines 2018: diagnostic criteria and severity grading of acute cholecystitis (with videos). *J Hepatobiliary Pancreat Sci.* 2018 Jan 1;25(1):41–54. Available: <https://doi.org/10.1002/jhbp.515>
6. Mencarini L, Vestito A, Zagari RM, Montagnani M. The Diagnosis and Treatment of Acute Cholecystitis: A Comprehensive Narrative Review for a Practical Approach. *J Clin Med.* 2024 May 3;13(9):2695. doi: 10.3390/jcm13092695. PMID:38731224; PMCID: PMC11084823.
7. Vagholkar DrK. Acute cholecystitis: Severity assessment and management. *International Journal of Surgery Science.* 2020 Apr 1;4(2):299–302. Available: <https://doi.org/10.33545/surgery.2020.v4.i2e.433>
8. Halpin V. Acute cholecystitis. *BMJ Clin Evid.* 2014 Aug 20;2014:0411. PMID: 25144428; PMCID: PMC4140413.
9. Bagla P, Sarria JC, Riall TS. Management of acute cholecystitis. *Curr Opin Infect Dis.* 2016 Oct;29(5):508-13. DOI: 10.1097/QCO.0000000000000297. PMID: 27429137.
10. Portincasa P, Moschetta A, Petruzzelli M, Palasciano G, Di Ciaula A, Pezzolla A. Gallstone disease: Symptoms and diagnosis of gallbladder stones. *Best Pract Res Clin Gastroenterol.* 2006;20(6): 1017-29. DOI:10.1016/j.bpg.2006.05.005. PMID: 17127185.
11. Shirah BH, Shirah HA, Saleem MA, Chughtai MA, Elraghi MA, Shams ME. Predictive factors for gangrene complication in acute calculous cholecystitis. *Ann Hepatobiliary Pancreat Surg.* 2019 Aug;23(3):228-233. DOI:10.14701/ahbps.2019.23.3.228. Epub 2019 Aug 30. PMID: 31501810; PMCID: PMC6728255.
12. Nikfarjam M, Niumsawatt V, Sethu A, Fink MA, Muralidharan V, Starkey G, Jones RM, Christophi C. Outcomes of contemporary management of gangrenous and non-gangrenous acute cholecystitis. *HPB (Oxford).* 2011 Aug; 13(8):551-8. DOI:10.1111/j.1477-2574.2011.00327.x. Epub 2011 Jun 3. PMID: 21762298; PMCID: PMC3163277.
13. Ares JÁD, García RM, Vidagany NE, Tomás NP, Roig MP, Gras MV, et al. Can inflammatory biomarkers help in the diagnosis and prognosis of gangrenous acute cholecystitis? A prospective study. *Revista Espanola de Enfermedades Digestivas.* 2021;113(1):41–4. Available: <http://dx.doi.org/10.17235/reed.2020.7282/2020>
14. Aydin C, Altaca G, Berber I, Tekin K, Kara M, Titiz I. Prognostic parameters for the prediction of acute gangrenous cholecystitis. *J Hepatobiliary Pancreat Surg.* 2006;13(2):155-9.

- DOI:10.1007/s00534-005-1042-8. PMID: 16547678.
15. Fagan SP, Awad SS, Rahwan K, Hira K, Aoki N, Itani KM, Berger DH. Prognostic factors for the development of gangrenous cholecystitis. *Am J Surg.* 2003 Nov;186(5):481-5. DOI:10.1016/j.amjsurg.2003.08.001. PMID: 14599611.
 16. Önder A, Kapan M, Ülger BV, Oğuz A, Türkoğlu A, Uslukaya Ö. Gangrenous cholecystitis: mortality and risk factors. *Int Surg.* 2015 Feb;100(2):254-60. DOI:10.9738/INTSURG-D-13-00222.1. PMID: 25692427; PMCID: PMC4337439.
 17. Oppenheimer DC, Rubens DJ. Sonography of Acute Cholecystitis and Its Mimics. *Radiol Clin North Am.* 2019 May;57(3):535-548. DOI:10.1016/j.rcl.2019.01.002. Epub 2019 Feb 10. PMID: 30928076.
 18. Bennett GL, Rusinek H, Lisi V, Israel GM, Krinsky GA, Slywotzky CM, Megibow A. CT findings in acute gangrenous cholecystitis. *AJR Am J Roentgenol.* 2002 Feb;178(2):275-81. DOI: 10.2214/ajr.178.2.1780275. PMID: 11804880.
 19. Bourikian S, Anand RJ, Aboutanos M, Wolfe LG, Ferrada P. Risk factors for acute gangrenous cholecystitis in emergency general surgery patients. *Am J Surg.* 2015 Oct;210(4):730-3. DOI: 10.1016/j.amjsurg.2015.05.003. Epub 2015 Jun 27. PMID: 26186803.
 20. Girgin S, Gedik E, Taçyıldız IH, Akgün Y, Baç B, Uysal E. Factors affecting morbidity and mortality in gangrenous cholecystitis. *Acta Chir Belg.* 2006 Sep-Oct;106(5):545-9. DOI:10.1080/00015458.2006.11679949. PMID: 17168267.
 21. Contini S, Corradi D, Busi N, Alessandri L, Pezzarossa A, Scarpignato C. Can gangrenous cholecystitis be prevented?: a plea against a "wait and see" attitude. *J Clin Gastroenterol.* 2004 Sep;38(8):710-6. DOI:10.1097/01.mcg.0000135898.68155.88. PMID: 15319657.
 22. Ganapathi AM, Speicher PJ, Englum BR, Perez A, Tyler DS, Zani S. Gangrenous cholecystitis: a contemporary review. *J Surg Res.* 2015 Jul;197(1):18-24. DOI:10.1016/j.jss.2015.02.058. Epub 2015 Mar 4. PMID: 25937567.
 23. Habib FA, Kolachalam RB, Khilnani R, Preventza O, Mittal VK. Role of laparoscopic cholecystectomy in the management of gangrenous cholecystitis. *Am J Surg.* 2001 Jan;181(1):71-5. DOI:10.1016/s0002-9610(00)00525-0. PMID: 11248180.
 24. Kashyap S, Mathew G, King KC. Gallbladder Empyema. 2023 Apr 10. In: *StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2024 Jan-. PMID: 29083646.*
 25. Fry DE, Cox RA, Harbrecht PJ. Empyema of the Gallbladder: A Complication in the Natural History of Acute Cholecystitis. Volume 141, Issue 3, 1981, 336-369; 1981 Available: [https://doi.org/10.1016/0002-9610\(81\)90198-7](https://doi.org/10.1016/0002-9610(81)90198-7).
 26. Zainal IA, Kew TY, Othman HA. Retrospective analysis of the sonographic and computed tomographic features of gallbladder empyema. *Emerg Radiol.* 2022 Apr;29(2):281-289. DOI: 10.1007/s10140-021-01996-1. Epub 2021 Nov 23. PMID: 34811585.
 27. Wee, Nicole Kessa, Cheong WS, Hsien Min Low. CT and MRI findings of acute calculous cholecystitis and its complications in Singapore: A pictorial review. *The Medical journal of Malaysia.* 2021;76(5):706-713.
 28. Malik A, Laghari AA, Talpur KA, Memon A, Mallah Q, Memon JM. Laparoscopic cholecystectomy in empyema of gall bladder: An experience at Liaquat University Hospital, Jamshoro, Pakistan. *J Minim Access Surg.* 2007 Apr;3(2):52-6. DOI: 10.4103/0972-9941.33273. PMID: 21124652; PMCID: PMC2980721.
 29. Masud, M. et al. 2018. Experience of laparoscopic cholecystectomy in empyema of gallbladder at tertiary care hospital: Cholecystectomy in Empyema of Gallbladder. *Pakistan Armed Forces Medical Journal.* Aug. 2018;68(4):818–21.
 30. Ambe PC, Jansen S, Macher-Heidrich S, Zirngibl H. Surgical management of empyematous cholecystitis: a register study of over 12,000 cases from a regional quality control database in Germany. *Surg Endosc.* 2016 Dec;30(12):5319-5324. DOI:10.1007/s00464-016-4882-1. Epub 2016 May 13. PMID: 27177953.
 31. El Zanati H, Nassar AHM, Zino S, Katbeh T, Ng HJ, Abdellatif A. Gall Bladder Empyema: Early Cholecystectomy during

- the Index Admission Improves Outcomes. *JLS*. 2020 Apr-Jun;24(2):e2020.00015. DOI: 10.4293/JLS.2020.00015. PMID: 32425482; PMID: PMC7208918.
32. Kwon YJ, Ahn BK, Park HK, Lee KS, Lee KG. What is the optimal time for laparoscopic cholecystectomy in gallbladder empyema? *Surg Endosc*. 2013 Oct;27(10):3776-80. DOI: 10.1007/s00464-013-2968-6. Epub 2013 May 4. PMID: 23644836.
33. Date RS, Thrumurthy SG, Whiteside S, Umer MA, Pursnani KG, Ward JB, Mughal MM. Gallbladder perforation: case series and systematic review. *Int J Surg*. 2012;10(2):63-8. DOI:10.1016/j.ijss.2011.12.004. Epub 2011 Dec 20. PMID: 22210542.
34. Derici H, Kara C, Bozdogan AD, Nazli O, Tansug T, Akca E. Diagnosis and treatment of gallbladder perforation. *World J Gastroenterol* 2006; 12(48): 7832-7836 [PMID: 17203529 DOI: 10.3748/wjg.v12.i48.7832]
35. Ausania F, Guzman Suarez S, Alvarez Garcia H, Senra del Rio P, Casal Nuñez E. Gallbladder perforation: morbidity, mortality and preoperative risk prediction. *Surg Endosc*. 2015 Apr;29(4):955-60. doi: 10.1007/s00464-014-3765-6. Epub 2014 Aug 27. PMID: 25159627.
36. Patel G, Jain A, Kumar RB, Singh N, Karim T, Mishra R. Gallbladder Perforation: A Prospective Study of Its Divergent Appearance and Management. *Euroasian J Hepatogastroenterol*. 2019 Jan-Jun;9(1):14-19. doi: 10.5005/jp-journals-10018-1289. PMID: 31988861; PMID: PMC6969324.
37. Lee, Kyong Joo MD, PhDa; Park, Se Woo MD, PhDa; Park, Da Hae BSNa; Cha, Hye Won BSNa; Choi, Ana BSca; Koh, Dong Hee MD, PhDa; Lee, Jin MD, PhDa; Lee, Jung Min MD; Park, Chan Hyuk MD, PhDc. Gallbladder perforation in acute acalculous vs. calculous cholecystitis: a retrospective comparative cohort study with 10-year single-center experience. *International Journal of Surgery* 110(3):1383-1391, March 2024. | DOI: 10.1097/JS9.0000000000000994
38. Jansen S, Stodolski M, Zirngibl H, Göttsche D, Ambe PC. Advanced gallbladder inflammation is a risk factor for gallbladder perforation in patients with acute cholecystitis. *World J Emerg Surg*. 2018 Feb 20;13:9. doi: 10.1186/s13017-018-0169-2. PMID: 29467816; PMID: PMC5819242.
39. Menakuru SR, Kaman L, Behera A, Singh R, Katariya RN. Current management of gall bladder perforations. *ANZ J Surg*. 2004 Oct;74(10):843-6. DOI:10.1111/j.1445-1433.2004.03186.x. PMID: 15456428.
40. Quiroga-Garza A, Alvarez-Villalobos NA, Angeles-Mar HJ, Garcia-Campa M, Muñoz-Leija MA, Salinas-Alvarez Y, Elizondo-Omaña RE, Guzmán-López S. Localized gallbladder perforation: a systematic review of treatment and prognosis. *HPB (Oxford)*. 2021 Nov;23(11):1639-1646. DOI: 10.1016/j.hpb.2021.06.003. Epub 2021 Jun 24. PMID: 34246546.
41. Gupta V, Chandra A, Gupta V, Patel R, Dangi A, Pai A. Gallbladder perforation: A single-center experience in north India and a step-up approach for management. *Hepatobiliary Pancreat Dis Int*. 2022 Apr;21(2):168-174. DOI: 10.1016/j.hbpd.2021.08.011. Epub 2021 Sep 8. PMID: 34548226.
42. Stefanidis D, Sirinek KR, Bingener J. Gallbladder perforation: risk factors and outcome. *J Surg Res*. 2006 Apr;131(2): 204-8. DOI:10.1016/j.jss.2005.11.580. Epub 2006 Jan 18. PMID: 16412466.
43. Rajput D, Gupta A, Kumar S, Singla T, Srikanth K, Chennatt J. Clinical spectrum and management outcome in gallbladder perforation-a sinister entity: Retrospective study from Sub-Himalayan region of India. *Turk J Surg*. 2022 Mar 28;38(1):25-35. DOI:10.47717/turkjsurg.2022.5325. PMID: 35873750; PMID: PMC9278357.
44. Wani AH, Iqbal J, Parihar S. A retrospective study of diagnosis and management of gallbladder perforation: 10-year experience from a tertiary health care centre. *Turk J Surg*. 2023 Jun 19;39(2):102-106. DOI:10.47717/turkjsurg.2023.5962. PMID: 38026912; PMID: PMC10681111.
45. Sahbaz NA, Peker KD, Kabuli HA, Gumusoglu AY, Alis H. Single center experience in laparoscopic treatment of gallbladder perforation. *Wideochir Inne*

- Tech Maloinwazyjne. 2017 Dec;12(4): 372-377.
DOI: 10.5114/wiitm.2017.72321.
Epub 2017 Dec 29.
PMID: 29362652;
PMCID: PMC5776488.
46. Al-Azzawi M, Abouelazayem M, Parmar C, Singhal R, Amr B, Martinino A, Atici SD, Mahawar K. A systematic review on laparoscopic subtotal cholecystectomy for difficult gallbladders: a lifesaving bailout or an incomplete operation? *Ann R Coll Surg Engl.* 2024 Mar;106(3):205-212.
DOI:10.1308/rcsann.2023.0008. Epub 2023 Jun 27. PMID: 37365939; PMCID: PMC10904265.
47. Toro A, Teodoro M, Khan M, Schembari E, Di Saverio S, Catena F, Di Carlo I. Subtotal cholecystectomy for difficult acute cholecystitis: how to finalize safely by laparoscopy-a systematic review. *World J Emerg Surg.* 2021 Sep 8;16(1):45.
DOI:10.1186/s13017-021-00392-x. PMID: 34496916; PMCID: PMC8424983.
48. Supit C, Supit T, Mazni Y, Basir I. The outcome of laparoscopic subtotal cholecystectomy in difficult cases - A case series. *Int J Surg Case Rep.* 2017;41:311-314.
DOI:10.1016/j.ijscr.2017.10.054. Epub 2017 Nov 8. PMID: 29132116; PMCID: PMC5684444.

Disclaimer/Publisher's Note: The statements, opinions and data contained in all publications are solely those of the individual author(s) and contributor(s) and not of the publisher and/or the editor(s). This publisher and/or the editor(s) disclaim responsibility for any injury to people or property resulting from any ideas, methods, instructions or products referred to in the content.

© Copyright (2024): Author(s). The licensee is the journal publisher. This is an Open Access article distributed under the terms of the Creative Commons Attribution License (<http://creativecommons.org/licenses/by/4.0>), which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

Peer-review history:
The peer review history for this paper can be accessed here:
<https://www.sdiarticle5.com/review-history/120446>