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Contents

Monthly Volume 16 Number 11 November 27, 2024

EDITORIAL

MINIREVIEWS

ORIGINAL ARTICLE

Retrospective Cohort Study

Retrospective Study

Contents

World Journal of Gastrointestinal Surgery

Monthly Volume 16 Number 11 November 27, 2024

Contents

World Journal of Gastrointestinal Surgery

Monthly Volume 16 Number 11 November 27, 2024

World Journal of Gastrointestinal Surgery

Monthly Volume 16 Number 11 November 27, 2024

Contents

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The primary aim of *World Journal of Gastrointestinal Surgery* (*WJGS*, *World J Gastrointest Surg*) is to provide scholars and readers from various fields of gastrointestinal surgery with a platform to publish high-quality basic and clinical research articles and communicate their research findings online.

WJGS mainly publishes articles reporting research results and findings obtained in the field of gastrointestinal surgery and covering a wide range of topics including biliary tract surgical procedures, biliopancreatic diversion, colectomy, esophagectomy, esophagostomy, pancreas transplantation, and pancreatectomy, *etc*.

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ORIGINAL ARTICLE

Retrospective Study

Effect of surgical timing on postoperative outcomes in patients with acute cholecystitis after delayed percutaneous transhepatic gallbladder drainage

Wei Gao, Jun Zheng, Ji-Gang Bai, Zhao Han

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Abstract

BACKGROUND

To date, the optimal timing for percutaneous transhepatic gallbladder drainage (PTGBD), particularly for patients who have missed the optimal window for emergency laparoscopic cholecystectomy (LC) (within 72 hours of symptom onset) has not been determined.

AIM

To study the effects of LC timing on outcomes of grade II/III acute cholecystitis (AC) in patients with delayed PTGBD.

METHODS

Data of patients diagnosed with Tokyo Guidelines 2018 grade II or III AC who underwent delayed PTGBD followed by LC at a single hospital between 2018 and 2022 were retrospectively studied. According to the interval between gallbladder drainage and cholecystectomy, the patients were divided into early and delayed LC groups. Outcomes including surgery time, postoperative complications and hospital stay, and patient satisfaction were analyzed and compared between the two groups using *t*- and χ^2 tests.

RESULTS
There were no significant differences between the two groups in intraoperative blood loss, postoperative abdominal drainage tube placement time, pain index, or total disease duration (all $P > 0.05$). Compared with those of the early LC group, the delayed group showed significant decreases in the length of procedure (surgery time), conversion rate to open surgery, degree of adhesions, surgical complications, postoperative hospital stay, and total treatment costs, and increased patient satisfaction despite a longer interval before PTGBD (all $P < 0.05$).

CONCLUSION
For patients with grade II/III AC with delayed PTGBD, LC should be performed 2 weeks after PTGBD to decrease postoperative complications and hospital stays and improve patient satisfaction.

Key Words: Acute cholecystitis; Percutaneous transhepatic gallbladder drainage; Laparoscopic cholecystectomy; Surgical timing; Postoperative outcomes

Core Tip: Previous studies have proposed that percutaneous transhepatic gallbladder drainage (PTGBD) should be performed as early as possible in patients with moderate-to-severe acute cholecystitis (AC). However, to date, no consensus has been reached on the optimal timing for PTGBD, particularly for patients who have missed the 72-hour emergency laparoscopic cholecystectomy (LC) window. This study assessed the effects of different operation times on postoperative outcomes of patients with grade II or III AC with delayed PTGBD (time from symptom onset to PTGBD exceeding 7 days). Our results suggest that LC should be performed 2 weeks after PTGBD.

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INTRODUCTION

Acute cholecystitis (AC) is a common acute abdominal disease in the field of general surgery. It is usually caused by inflammation of the gallbladder wall caused by the stimulation or entrapment of gallstones in the gallbladder duct or bacterial infection. AC occurs rapidly and is associated with severe symptoms. If left untreated, complications such as gallbladder necrosis, gallbladder perforation, and sepsis may occur; in severe cases, AC can be life-threatening[1-3]. According to the Tokyo Guidelines 2018 (TG18), emergency laparoscopic cholecystectomy (LC) is an important early treatment option for AC[4]. However, for patients with moderate-to-severe AC, because of the increased difficulty of surgery and postoperative complications, and the fact that such patients often are of advanced age, have underlying diseases, and are in poor general condition, conservative treatment can be administered first. Treatment may include the administration of antibiotics or percutaneous transhepatic gallbladder drainage (PTGBD) to control infection before patients undergo elective surgery[5-7].

Although studies show that PTGBD should be performed as early as possible in patients with moderate-to-severe AC [8-11], there is no consensus on the optimal timing for PTGBD. In clinical practice, patients, particularly those referred from grassroots hospitals, will commonly seek medical attention after undergoing conservative drug treatment for more than 1 week with poor efficacy. These patients miss the optimal 72-hour emergency LC window and the possibility of undergoing early PTGBD. To date, few studies have considered the effect of delayed PTGBD on subsequent LC procedures.

Therefore, the present study investigated the effects of different operation times on the postoperative outcomes of patients with grade II or III AC with delayed PTGBD (time from symptom onset to PTGBD exceeding 7 days).

MATERIALS AND METHODS

Ethical approval

This study was conducted in accordance with the Declaration of Helsinki and approved by the Ethics Committee of No. 215 Hospital of Shaanxi Nuclear Industry (No: 2024-011).

Patient selection

This retrospective study was conducted between January 2018 and December 2022. The data of all patients diagnosed with TG18 grade II or III[12] AC who underwent delayed PTGBD followed by LC at the No. 215 Hospital of Shaanxi

Nuclear Industry, were assessed.

The exclusion criteria were as follows: (1) History of upper abdominal surgery; (2) Obstructive jaundice caused by malignant diseases; (3) Pregnancy or lactation; (4) Undergoing medication treatment, such as oral anti-tuberculosis and anti-tumor drugs; and (5) Incomplete clinical data.

Finally, 68 patients were included and divided into two groups: (1) Early LC group (n = 32), for patients in whom the interval between PTGBD and LC was less than 2 weeks; and (2) Delayed LC group (n = 36), for patients in whom the interval between PTGBD and LC exceeded 2 weeks.

PTGBD technique

Preoperatively, patients were prohibited from eating and drinking for 12 hours and administered anti-infection, antispasmodic, and analgesic medications. Moreover, any internal environment disorders were correctified and appropriate strategies were used to manage blood pressure and blood glucose levels.

PTGBD at our hospital is performed using the Seldinger puncture technique under ultrasonographic guidance. The technique is performed as follows. (1) The patient is placed in a supine position with no pillow, and ultrasonography is conducted on the gallbladder area. The puncture point is determined between the 7th and 8th ribs on the right side; (2) The puncture area is routinely disinfected and draped, and local infiltration anesthesia is administered using lidocaine (2%); (3) A 3.0-4.0 mm incision is made at the puncture point. Under ultrasonographic guidance, a puncture needle is inserted to enter the gallbladder through the middle and upper one-third of the gallbladder bed; (4) The outflow of bile is observed, followed by insertion of the guide wire along the puncture needle which is subsequently retrieved; (5) The skin expander is used to expand the skin and intercostal muscles, and a 12-French pigtail drainage tube is inserted along the guide wire; (6) The guide wire is removed and ultrasound is conducted to confirm that the tail of the drainage tube is located inside the gallbladder; (7) The drainage tube is secured in place using silk thread; the area is then wrapped in sterile patches, and the tube is connected to a sterile drainage bag; and (8) Postoperatively, bile is extracted for bacterial culture and drug sensitivity testing. Patients are monitored for abdominal changes/symptoms, bile drainage volume and color, and to ensure that the drainage tube remains unobstructed and well secured.

Secondary surveys of the gallbladder using ultrasound or computed tomography are performed in cases in which postoperative abdominal pain, high fever, and a continuous increase in white blood cell count exceed 24 hours.

LC technique

All patients undergo a comprehensive preoperative examination to rule out surgical contraindications. The preoperative measures are the same as that for PTGBD. All patients undergo tracheal intubation under general anesthesia. The three-hole method is used for LC, and the specific steps are as follows. (1) The area is prepared with conventional disinfection and placement of sterile drapes; (2) A small incision is made at the navel followed by a 1-cm incision to separate the tissue; (3) A puncture needle is inserted to establish a carboxy peritoneum with a pressure of 12 mmHg, and a laparoscope is inserted; (4) Laparoscopic exploration of the abdominal cavity is conducted focusing on the gallbladder triangle, gallbladder, and liver adhesions; (5) Subsequently, under laparoscopic guidance, a 10-mm diameter trocar is inserted into the main operating hole (hole B), 1 cm below the xiphoid process, and a 5-mm diameter trocar is inserted into the auxiliary operating hole (hole C) 3-5 cm below the junction of the midline of the right clavicle and rib arch; (6) The gallbladder triangle is fully exposed, and non-absorbable ligation clamps are used to close and cut the cystic artery and duct. The gallbladder is peeled from its bed, excised, and a drainage tube is placed in the gallbladder bed; (7) The abdominal carbon dioxide is released, and the incision is sutured. When dense adhesions around the neck of the gallbladder cause difficulty in dissecting the gallbladder triangle or when intraoperative damage to blood vessels leads to uncontrollable bleeding, timely conversion to open surgery is performed; and (8) Postoperative treatment includes routine fluid replacement and antibacterial therapy. The time to removal of the drainage tube is determined based on the amount and color of the drainage and bedside ultrasound results.

Outcome measures

The surgical time, intraoperative blood loss, degree of adhesion, conversion to open surgery rate, abdominal drainage tube placement time, pain index, postoperative complications, postoperative hospital stay, total disease duration, total treatment cost, and patient satisfaction were compared between the two patient groups.

Quality control

PTGBD and LC were performed by senior surgeons with comparable operational experience who are ranked as deputy chief physicians or above. The determination of the degree of gallbladder adhesion during LC is subjective; there is currently no quantitative evaluation method to measure adhesion. To minimize the subjective impact for this study, we referred to "tight adhesion between the gallbladder triangle and surrounding tissues" as documented in surgical records as ‘severe adhesion’ and referred to other amounts as ‘mild adhesion’.

Statistical analysis

Statistical analyses were conducted using SPSS software (version 22.0; SPSS, Inc., Chicago, IL, United States). LC operative time, intraoperative blood loss, number of complications, and other measurement data are expressed as means ± SD and were analyzed using a twotail paired Student's t-test. The conversion rate to open surgery, degree of adhesions, and other count data are expressed as n (%) and were analyzed using the χ^2 test. Statistical significance was set at $P < 0.05$.

RESULTS

Baseline characteristics

There were no significant differences in demographics or preoperative clinical features between the two groups (all $P > 0.05$; Table 1).

Indications and complications of PTGBD

PTGBD tubes were successfully placed under ultrasound guidance in all 68 patients, with a puncture success rate of 100% (Figure 1). Among them, 49 patients experienced significant relief from abdominal pain 3-6 hours after the procedure, while the remaining 19 patients experienced partial relief.

There was no significant difference between the early and delayed LC groups in PTGBD indications such as septic shock and gallbladder perforation (all $P > 0.05$; Table 2). There was no significant difference between the two groups in PTGBD-related complications such as catheter detachment and bile leakage (all $P > 0.05$; Table 3). One patient in the early LC group presented with minor bleeding complications (50 mL), which were controlled with coagulation drugs and intravenous infusion. No PTGBD-related deaths occurred in either group.

Postoperative outcomes

There were no significant differences between the early and delayed LC groups in intraoperative blood loss, postoperative abdominal drainage tube placement time, pain index, or total disease duration (all $P > 0.05$). Compared with the early LC group, the delayed LC group showed a significant decrease in LC operative time, conversion rate to open surgery, degree of adhesions, surgical complications, postoperative hospital stay, and total treatment costs, and increased patient satisfaction despite a longer PTGBD tube placement time (all $P < 0.05$) (Table 4).

DISCUSSION

LC is the current standard surgical method for AC[13-15]. Compared with open cholecystectomy, LC has no significant differences in surgical time and mortality rate; however, the recovery time of patients after LC is significantly reduced[16-19]. Regarding the timing of LC, studies have shown that compared with delayed LC, early LC (performed within 72 hours after admission) has a significantly lower mortality rate and incidence of complications such as bile leakage and wound infections[20]. The 2018 Tokyo Guidelines recommend that LC be performed within 72 h of symptom onset[4].

However, with the aging of the population and increasing prevalence of chronic diseases such as diabetes, coronary heart disease, chronic heart failure, and chronic obstructive pulmonary disease, some patients with these comorbidities and high-risk factors cannot tolerate emergency LC. Affected patients have a mortality rate of up to 35%[21] and a relatively high incidence of postoperative complications such as biliary tract injury and biliary fistula[22-25]. PTGBD technology was developed to alleviate general systemic symptoms and reduce complications[26-28]. Clinical studies have shown that PTGBD can improve symptoms safely during the critical period. After the general condition of the patient improves, surgery can be performed to remove the gallbladder. At this point, the surgical risk is significantly reduced [29]. In the present study, the collected data were from patients with TG18 grade II or III AC unable to undergo emergency LC owing to high-risk factors who underwent PTGBD, with a time interval between symptom onset and PTGBD exceeding 7 days. After the patients' general conditions improved, LC was performed.

Currently, there is no consensus on the optimal timing of LC after PTGBD, and there are few reports on the impact of the timing of PTGBD on subsequent LC outcomes. Previous studies have shown that compared with delayed surgery, early surgery (PTGBD to LC two interval < 72 hours) may lead to increased intraoperative blood loss, prolonged surgical time, and increased complications[30,31]. Inoue *et al*[32] showed that compared with patients with a PTGBD to LC interval of ≥ 9 days, patients with an interval of < 9 days had a significant increase in complications (35.7 *vs* 7.6%; $P = 0.006$). Jung and Park[33] conducted a comparative study with groups based on PTGBD to LC intervals of < 10 days or ≥ 10 days and obtained similar results. Altieri *et al*[34] compared the effectiveness of cholecystectomy with PTGBD to LC surgery intervals of < 8 weeks and ≥ 8 weeks and found that patients in the early group had more complications and longer hospital stays.

However, not all studies have shown that a longer interval between PTGBD and LC leads to better outcomes. Sakamoto *et al*[35] divided patients into groups based on the interval between PTGBD and LC procedures and analyzed the results using restricted cubic spline curves. They found that compared with patients with a 10-day interval, patients with a PTGBD to LC interval of ≤ 6 days or ≥ 27 days had a higher mortality rate and incidence of complications. Compared with patients with a 15-day interval, patients with a PTGBD to LC interval of ≤ 10 days or ≥ 19 days had longer hospital stays.

Based on previous studies and in particular Sakamoto *et al*'s mathematical model[35], we adopted 14 days as the cutoff point for the PTGBD to LC interval and divided patients into an early LC group (< 14 days) and a delayed LC group (≥ 14 days). There were no significant differences in the indications for or complications of PTGBD catheterization between the two groups. Consistent with previous results, our research indicated that compared with patients in the early LC group, patients in the delayed LC group showed a significant decrease in LC operative time, conversion rate to open surgery, degree of adhesions, surgical complications, postoperative hospital stay, and total treatment costs, and higher patient satisfaction despite a longer PTGBD tube placement time (all $P < 0.05$).

Table 1 Baseline characteristics of the two groups before percutaneous transhepatic gallbladder drainage, mean ± SD

Variables	Early LC group (*n* = 32)	Delayed LC group (*n* = 36)	*P* value
Sex (male/female)	18/14	20/16	0.954
Age (years)	65.4 ± 15.2	62.1 ± 17.3	0.823
BMI (kg/m^2)	25.26 ± 4.28	24.36 ± 3.19	0.428
Etiology (with/without stone)	30/2	35/1	0.486
Grade of AC (II/III)	14/18	23/13	0.096
CCI (< 4/≥ 4)	15/17	14/22	0.506
ASA-PS class (< 3/≥ 3)	12/20	16/20	0.561
Time from symptom onset to PTGBD (days)	8.9 ± 1.1	9.2 ± 1.3	0.748

PTGBD: Percutaneous transhepatic gallbladder drainage; LC: Laparoscopic cholecystectomy; BMI: Body Mass Index; CCI: Charlson Comorbidity Index; ASA-PS: American Society of Anesthesiologists Physical Status.

Table 2 Indications for percutaneous transhepatic gallbladder drainage catheterization in the patient groups, *n* (%)

Indications	Early LC group	Delayed LC group	*P* value
Septic shock	14 (43.8)	12 (33)	0.378
Gallbladder perforation	10 (31.3)	11 (30.6)	0.951
Progressive abdominal pain	5 (15.6)	8 (22.2)	0.490
Persistent high fever	2 (6.3)	3 (8.3)	0.743
Sepsis	1 (3.1)	2 (5.6)	0.626
Cardiovascular dysfunction	5 (15.6)	7 (19.4)	0.680
Neurological dysfunction	0 (0)	1 (2.7)	0.342
Respiratory dysfunction	6 (18.8)	11 (30.6)	0.262
Liver or kidney dysfunction	8 (25)	5 (13.0)	0.245
Coagulation disorders	1 (3.1)	0 (0)	0.285

LC: Laparoscopic cholecystectomy.

Table 3 Percutaneous transhepatic gallbladder drainage catheterization complications in the patient groups, *n* (%)

Complications	Early LC group	Delayed LC group	*P* value
Catheter detachment	2 (6.3)	1 (2.8)	0.486
Bile leakage	2 (6.3)	2 (5.6)	0.903
Biliary peritonitis	1 (3.1)	1 (2.8)	0.933
Infection	0 (0.0)	1 (2.8)	0.342
Hemorrhage	1 (3.1)	0 (0.0)	0.285

LC: Laparoscopic cholecystectomy.

We believe that the difference in postoperative outcomes between the two groups was a result of the different timing of the LC. The time between the onset of cholecystitis symptoms and LC was longer in the delayed LC group than the early LC group (31.2 ± 6.7 *vs* 23.0 ± 5.2 days). After the pressure inside the gallbladder has been reduced, the infected bile has been drained, and medicinal treatment has been administered, the gallbladder enters a phase of inflammation resolution, and the degree of adhesion is reduced. Therefore, the difficulty of surgery is reduced, and as seen by findings of the present study, this resulted in the operating time, conversion rate to open surgery, and incidence of surgical complications being lower in the delayed LC group than those in the early LC group. In addition, owing to the shortened

Table 4 Surgical outcomes between the two groups of patients after PTGBD, mean ± SD

Outcome measures	Early LC group (*n* = 32)	Delayed LC group (*n* = 36)	*P* value
LC surgery time (minute)	108.3 ± 14.2	90.2 ± 12.2	< 0.001
Intraoperative blood loss (mL)	15.4 ± 5.1	16.0 ± 4.3	0.474
Operation (LC/ laparotomy)	21/11	32/4	0.021
Degree of adhesions (mild/severe)	20/12	33/3	0.004
Number of complications	9	2	0.012
Surgical site infection	3	1	0.248
Bile leakage	2	1	0.486
Hemorrhage	2	0	0.128
Pulmonary infection	1	0	0.285
Hyperamylasemia	1	0	0.285
Abdominal drainage tube placement time (day)	1.9 ± 0.7	2.0 ± 0.7	0.378
Postoperative hospital stay	9.1 ± 4.1	3.0 ± 0.9	< 0.001
PTGBD drainage tube placement time (day)	10.8 ± 1.6	19.8 ± 4.0	< 0.001
Pain index (0-10)	3.3 ± 1.3	3.7 ± 1.1	0.083
Patient satisfaction (%)	80.5 ± 11.5	85.3 ± 9.8	0.028
Total disease duration (day)	32.1 ± 5.3	33.2 ± 5.1	0.125
Total treatment costs (Yuan)	23570.9 ± 4996.1	21144.7 ± 2065.5	0.002

PTGBD: Percutaneous transhepatic gallbladder drainage; LC: Laparoscopic cholecystectomy.

Figure 1 Computed tomography of patients with acute cholecystitis after percutaneous transhepatic gallbladder drainage catheterization.
The arrow shows the drainage tube inside the gallbladder.

postoperative hospitalization time, the total treatment cost of patients with delayed LC decreased and patient satisfaction improved.

If the interval between PTGBD and LC is too short, the Calot's triangle of the gallbladder will have increased inflammatory edema, and the boundary with the surrounding common bile duct, duodenum, and greater omentum will be blurred, easily leading to procedure-related injuries to the biliary and/or intestinal tract. However, if the interval is too long, stimulation of the drainage tube on the gallbladder mucosa and the persistent presence of stones can induce chronic inflammation, forming tough, dense adhesions with the surrounding tissues. Simultaneously, gallbladder atrophy can significantly increase the difficulty of secondary surgery.

This study had some potential limitations. First, the sample size was relatively small. Second, this was a single-center study; therefore, the results may have been affected by local conditions. More large-scale multicenter studies are required to confirm these findings.

CONCLUSION

In conclusion, we suggest that for patients with grade II or III AC and delayed PTGBD (time from symptom onset to PTGBD exceeding 7 days), LC should be performed 2 weeks after PTGBD. At this time, the difficulty of surgery decreased, the incidence of postoperative complications was low, and the patients' postoperative hospitalization time and total treatment cost were significantly reduced.

FOOTNOTES

Author contributions: Gao W and Han Z contributed to the study conception and design; Gao W, Zheng J and Bai JG performed material preparation, data collection and analysis, and wrote the first draft of the manuscript; Han Z reviewed and revised the manuscript; all authors read and approved the final manuscript.

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REFERENCES

1 **Adachi T**, Eguchi S, Muto Y. Pathophysiology and pathology of acute cholecystitis: A secondary publication of the Japanese version from 1992. *J Hepatobiliary Pancreat Sci* 2022; **29**: 212-216 [PMID: 33570821 DOI: 10.1002/jhbp.912]
2 **Jang YR**, Ahn SJ, Choi SJ, Lee KH, Park YH, Kim KK, Kim HS. Acute cholecystitis: predictive clinico-radiological assessment for conversion of laparoscopic cholecystectomy. *Acta Radiol* 2020; **61**: 1452-1462 [PMID: 32228032 DOI: 10.1177/0284185120906658]
3 **Tanaka K**, Takano Y, Kigawa G, Shiozawa T, Takahashi Y, Nagahama M. Percutaneous transhepatic gallbladder drainage versus endoscopic gallbladder stenting for managing acute cholecystitis until laparoscopic cholecystectomy. *Asian J Endosc Surg* 2024; **17**: e13253 [PMID: 37837367 DOI: 10.1111/ases.13253]
4 **Takada T**. Tokyo Guidelines 2018: updated Tokyo Guidelines for the management of acute cholangitis/acute cholecystitis. *J Hepatobiliary Pancreat Sci* 2018; **25**: 1-2 [PMID: 29334699 DOI: 10.1002/jhbp.526]
5 **Yu B**, Zhi X, Li Q, Xu B, Dong Z, Li T, Chen Z. The efficacy and safety of preoperative cholangiography *via* percutaneous transhepatic gallbladder drainage (PTGBD) for difficult laparoscopic cholecystectomy (LC). *Surg Endosc* 2022; **36**: 1355-1361 [PMID: 34013391 DOI: 10.1007/s00464-021-08414-0]
6 **Lee R**, Ha H, Han YS, Kwon HJ, Ryeom H, Chun JM. Percutaneous transhepatic gallbladder drainage followed by elective laparoscopic cholecystectomy for patients with moderate to severe acute cholecystitis. *Medicine (Baltimore)* 2017; **96**: e8533 [PMID: 29095318 DOI: 10.1097/MD.0000000000008533]
7 **Bao J**, Wang J, Shang H, Hao C, Liu J, Zhang D, Han S, Li Z. The choice of operation timing of laparoscopic cholecystectomy (LC) after percutaneous transhepatic gallbladder drainage (PTGBD) for acute cholecystitis: a retrospective clinical analysis. *Ann Palliat Med* 2021; **10**: 9096-9104 [PMID: 34488395 DOI: 10.21037/apm-21-1906]
8 **Abe K**, Suzuki K, Yahagi M, Murata T, Sako H, Ishii Y. The Efficacy of PTGBD for Acute Cholecystitis Based on the Tokyo Guidelines 2018. *World J Surg* 2019; **43**: 2789-2796 [PMID: 31399798 DOI: 10.1007/s00268-019-05117-5]
9 **Mu P**, Lin Y, Zhang X, Lu Y, Yang M, Da Z, Gao L, Mi N, Li T, Liu Y, Wang H, Wang F, Leung JW, Yue P, Meng W, Zhou W, Li X. The evaluation of ENGBD versus PTGBD in high-risk acute cholecystitis: A single-center prospective randomized controlled trial. *EClinicalMedicine* 2021; **31**: 100668 [PMID: 33385126 DOI: 10.1016/j.eclinm.2020.100668]
10 **Park JH**, Jin DR, Kim DJ. Change in quality of life between primary laparoscopic cholecystectomy and laparoscopic cholecystectomy after percutaneous transhepatic gall bladder drainage. *Medicine (Baltimore)* 2022; **101**: e28794 [PMID: 35119050 DOI: 10.1097/MD.0000000000028794]
11 **Kaneta A**, Sasada H, Matsumoto T, Sakai T, Sato S, Hara T. Efficacy of endoscopic gallbladder drainage in patients with acute cholecystitis. *BMC Surg* 2022; **22**: 224 [PMID: 35690750 DOI: 10.1186/s12893-022-01676-y]

12 **Ie M**, Katsura M, Kanda Y, Kato T, Sunagawa K, Mototake H. Laparoscopic subtotal cholecystectomy after percutaneous transhepatic gallbladder drainage for grade II or III acute cholecystitis. *BMC Surg* 2021; **21**: 386 [PMID: 34717615 DOI: 10.1186/s12893-021-01387-w]

13 **Sedaghat N**, Cao AM, Eslick GD, Cox MR. Laparoscopic versus open cholecystectomy in pregnancy: a systematic review and meta-analysis. *Surg Endosc* 2017; **31**: 673-679 [PMID: 27324332 DOI: 10.1007/s00464-016-5019-2]

14 **Nassar A**, Elshahat I, Forsyth K, Shaikh S, Ghazanfar M. Outcome of early cholecystectomy compared to percutaneous drainage of gallbladder and delayed cholecystectomy for patients with acute cholecystitis: systematic review and meta-analysis. *HPB (Oxford)* 2022; **24**: 1622-1633 [PMID: 35597717 DOI: 10.1016/j.hpb.2022.04.010]

15 **Reddy S**, Jagtap N, Kalapala R, Ramchandani M, Lakhtakia S, Basha J, Nabi Z, Karyampudi A, Chavan R, Tandan M, Gupta R, Reddy DN. Choledocholithiasis in acute calculous cholecystitis: guidelines and beyond. *Ann Gastroenterol* 2021; **34**: 247-252 [PMID: 33654367 DOI: 10.20524/aog.2020.0562]

16 **Barka M**, Jarrar MS, Ben Abdessalem Z, Hamila F, Youssef S. Early laparoscopic cholecystectomy for acute cholecystitis: Does age matter? *Geriatr Gerontol Int* 2023; **23**: 671-675 [PMID: 37463676 DOI: 10.1111/ggi.14643]

17 **Keele T**, Hashemzadeh M, Movahed MR. Lower myocardial infarction and all-cause mortality with laparoscopic cholecystectomy compared with open cholecystectomy. *Future Cardiol* 2023; **19**: 759-765 [PMID: 38112267 DOI: 10.2217/fca-2023-0102]

18 **Cirocchi R**, Kwan SH, Popivanov G, Ruscelli P, Lancia M, Gioia S, Zago M, Chiarugi M, Fedeli P, Marzaioli R, Di Saverio S. Routine drain or no drain after laparoscopic cholecystectomy for acute cholecystitis. *Surgeon* 2021; **19**: 167-174 [PMID: 32713729 DOI: 10.1016/j.surge.2020.04.011]

19 **Hsu FL**, Ho TW, Chang C, Wu JM, Lin MT. Chemical composition of smoke produced by open versus laparoscopic surgery for cholecystectomy. *HPB (Oxford)* 2022; **24**: 1335-1340 [PMID: 35219594 DOI: 10.1016/j.hpb.2022.02.002]

20 **Cao AM**, Eslick GD, Cox MR. Early laparoscopic cholecystectomy is superior to delayed acute cholecystitis: a meta-analysis of case-control studies. *Surg Endosc* 2016; **30**: 1172-1182 [PMID: 26139487 DOI: 10.1007/s00464-015-4325-4]

21 **Agresta F**, Campanile FC, Vettoretto N, Silecchia G, Bergamini C, Maida P, Lombari P, Narilli P, Marchi D, Carrara A, Esposito MG, Fiume S, Miranda G, Barlera S, Davoli M; Italian Surgical Societies Working Group. Laparoscopic cholecystectomy: consensus conference-based guidelines. *Langenbecks Arch Surg* 2015; **400**: 429-453 [PMID: 25850631 DOI: 10.1007/s00423-015-1300-4]

22 **Fletcher E**, Seabold E, Herzing K, Markert R, Gans A, Ekeh AP. Laparoscopic cholecystectomy in the Acute Care Surgery model: risk factors for complications. *Trauma Surg Acute Care Open* 2019; **4**: e000312 [PMID: 31565675 DOI: 10.1136/tsaco-2019-000312]

23 **Kong KK**, Zhao YQ, Yan PB, Wang CY. Risk Assessment of Perioperative Nursing and Its Clinical Effectiveness in Patients Undergoing Interventional Surgery for Liver Cancer: A Discussion. *J Mod Nurs Pract Res* 2023; **3**: 7 [DOI: 10.53964/jmnpr.2023007]

24 **Lee SW**, Yang SS, Chang CS, Yeh HJ. Impact of the Tokyo guidelines on the management of patients with acute calculous cholecystitis. *J Gastroenterol Hepatol* 2009; **24**: 1857-1861 [PMID: 19686411 DOI: 10.1111/j.1440-1746.2009.05923.x]

25 **Zou Q**, Ding Y, Li CS, Yang XP. A randomized controlled trial of emergency LCBDE + LC and ERCP + LC in the treatment of choledocholithiasis with acute cholangitis. *Wideochir Inne Tech Maloinwazyjne* 2022; **17**: 156-162 [PMID: 35251401 DOI: 10.5114/wiitm.2021.108214]

26 **Cirocchi R**, Amato L, Ungania S, Buononato M, Tebala GD, Cirillo B, Avenia S, Cozza V, Costa G, Davies RJ, Sapienza P, Coccolini F, Mingoli A, Chiarugi M, Brachini G. Management of Acute Cholecystitis in High-Risk Patients: Percutaneous Gallbladder Drainage as a Definitive Treatment vs. Emergency Cholecystectomy-Systematic Review and Meta-Analysis. *J Clin Med* 2023; **12** [PMID: 37568306 DOI: 10.3390/jcm12154903]

27 **Lyu Y**, Li T, Wang B, Cheng Y. Early laparoscopic cholecystectomy after percutaneous transhepatic gallbladder drainage for acute cholecystitis. *Sci Rep* 2021; **11**: 2516 [PMID: 33510242 DOI: 10.1038/s41598-021-82089-4]

28 **Xia LL**, Su T, Li Y, Mao JF, Zhang QH, Liu YY. Improving rehabilitation and quality of life after percutaneous transhepatic cholangiography drainage with a rapid rehabilitation model. *World J Clin Cases* 2021; **9**: 10530-10539 [PMID: 35004984 DOI: 10.12998/wjcc.v9.i34.10530]

29 **Akyürek N**, Salman B, Yüksel O, Tezcaner T, Irkörücü O, Yücel C, Oktar S, Tatlicioğlu E. Management of acute calculous cholecystitis in high-risk patients: percutaneous cholecystotomy followed by early laparoscopic cholecystectomy. *Surg Laparosc Endosc Percutan Tech* 2005; **15**: 315-320 [PMID: 16340560 DOI: 10.1097/01.sle.0000191619.02145.c0]

30 **Han IW**, Jang JY, Kang MJ, Lee KB, Lee SE, Kim SW. Early versus delayed laparoscopic cholecystectomy after percutaneous transhepatic gallbladder drainage. *J Hepatobiliary Pancreat Sci* 2012; **19**: 187-193 [PMID: 21938408 DOI: 10.1007/s00534-011-0458-6]

31 **Choi JW**, Park SH, Choi SY, Kim HS, Kim TH. Comparison of clinical result between early laparoscopic cholecystectomy and delayed laparoscopic cholecystectomy after percutaneous transhepatic gallbladder drainage for patients with complicated acute cholecystitis. *Korean J Hepatobiliary Pancreat Surg* 2012; **16**: 147-153 [PMID: 26388926 DOI: 10.14701/kjhbps.2012.16.4.147]

32 **Inoue K**, Ueno T, Nishina O, Douchi D, Shima K, Goto S, Takahashi M, Shibata C, Naito H. Optimal timing of cholecystectomy after percutaneous gallbladder drainage for severe cholecystitis. *BMC Gastroenterol* 2017; **17**: 71 [PMID: 28569137 DOI: 10.1186/s12876-017-0631-8]

33 **Jung WH**, Park DE. Timing of Cholecystectomy after Percutaneous Cholecystostomy for Acute Cholecystitis. *Korean J Gastroenterol* 2015; **66**: 209-214 [PMID: 26493506 DOI: 10.4166/kjg.2015.66.4.209]

34 **Altieri MS**, Yang J, Yin D, Brunt LM, Talamini MA, Pryor AD. Early cholecystectomy (≤ 8 weeks) following percutaneous cholecystostomy tube placement is associated with higher morbidity. *Surg Endosc* 2020; **34**: 3057-3063 [PMID: 31372890 DOI: 10.1007/s00464-019-07050-z]

35 **Sakamoto T**, Fujiogi M, Matsui H, Fushimi K, Yasunaga H. Timing of cholecystectomy after percutaneous transhepatic gallbladder drainage for acute cholecystitis: a nationwide inpatient database study. *HPB (Oxford)* 2020; **22**: 920-926 [PMID: 31732466 DOI: 10.1016/j.hpb.2019.10.2438]

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