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GUIDELINE

TG13: Updated Tokyo Guidelines for acute cholangitis and acute cholecystitis

TG13 surgical management of acute cholecystitis

Yuichi Yamashita · Tadahiro Takada · Steven M. Strasberg · Henry A. Pitt · Dirk J. Gouma · O. James Garden · Markus W. Büchler · Harumi Gomi · Christos Dervenis · John A. Windsor · Sun-Whe Kim · Eduardo de Santibanes · Robert Padbury · Xiao-Ping Chen · Angus C. W. Chan · Sheung-Tat Fan · Palepu Jagannath · Toshihiko Mayumi · Masahiro Yoshida · Fumihiko Miura · Toshio Tsuyuguchi · Takao Itoi · Avinash N. Supe

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Abstract
Background Laparoscopic cholecystectomy is now accepted as a surgical procedure for acute cholecystitis when it is performed by an expert surgeon. There are several lines of strong evidence, such as randomized controlled trials (RCTs) and meta-analyses, supporting the introduction of laparoscopic cholecystectomy for patients with acute cholecystitis. The updated Tokyo Guidelines 2013 (TG13) describe the surgical treatment for acute cholecystitis according to the grade of severity, the timing, and the procedure used for cholecystitis in a question-and-answer format using the evidence concerning surgical management of acute cholecystitis.
Methods and materials Forty-eight publications were selected for a careful examination of their full texts, and the types of surgical management of acute cholecystitis were investigated using this evidence. The items concerning the surgical management of acute cholecystitis were the optimal surgical treatment for acute cholecystitis according to

Y. Yamashita (✉)
Department of Gastroenterological Surgery, Fukuoka University Hospital, Fukuoka University School of Medicine, 7-45-1 Nanakuma, Jonan-ku, Fukuoka 814-0180, Japan
e-mail: yuichiya@fukuoka-u.ac.jp

T. Takada · F. Miura
Department of Surgery, Teikyo University School of Medicine, Tokyo, Japan

S. M. Strasberg
Section of Hepatobiliary and Pancreatic Surgery, Washington University in Saint Louis School of Medicine, Saint Louis, MO, USA

H. A. Pitt
Department of Surgery, Indiana University School of Medicine, Indianapolis, IN, USA

D. J. Gouma
Department of Surgery, Academic Medical Center, Amsterdam, The Netherlands

O. J. Garden
Clinical Surgery, The University of Edinburgh, Edinburgh, UK

M. W. Büchler
Department of Surgery, University of Heidelberg, Heidelberg, Germany

H. Gomi
Center for Clinical Infectious Diseases, Jichi Medical University, Tochigi, Japan

C. Dervenis
First Department of Surgery, Agia Olga Hospital, Athens, Greece

J. A. Windsor
Department of Surgery, The University of Auckland, Auckland, New Zealand

S.-W. Kim
Department of Surgery, Seoul National University College of Medicine, Seoul, Korea

E. de Santibanes
Department of Surgery, Hospital Italianio, University of Buenos Aires, Buenos Aires, Argentina

R. Padbury
Division of Surgical and Specialty Services, Flinders Medical Centre, Adelaide, Australia

X.-P. Chen
Department of Surgery, Hepatic Surgery Centre, Tongji Hospital, Tongi Medical College, Huazhong Universty of Science and Technology, Wuhan, China

the grade of severity, optimal timing for the cholecystectomy, surgical procedure used for cholecystectomy, optimal timing of the conversion of cholecystectomy from laparoscopic to open surgery, and the complications of laparoscopic cholecystectomy.

Results There were eight RCTs and four meta-analyses concerning the optimal timing of the cholecystectomy. Consequently, it was found that cholecystectomy is preferable early after admission. There were three RCTs and two meta-analyses concerning the surgical procedure, which concluded that laparoscopic cholecystectomy is preferable to open procedures. Literature concerning the surgical treatment according to the grade of severity could not be quoted, because there have been no publications on this topic. Therefore, the treatment was determined based on the general opinions of professionals.

Conclusion Surgical management of acute cholecystitis in the updated TG13 is fundamentally the same as in the Tokyo Guidelines 2007 (TG07), and the concept of a critical view of safety and the existence of extreme vasculobiliary injury are added in the text to call the surgeon's attention to the need to reduce the incidence of bile duct injury.

Free full-text articles and a mobile application of TG13 are available via http://www.jshbps.jp/en/guideline/tg13.html.

Keywords Acute cholecystitis · Laparoscopic cholecystectomy · Cholecystostomy · Bile duct injury · Gallbladder drainage

Introduction

Cholecystectomy has been widely used as a surgical procedure for acute cholecystitis. There have been several studies on the timing of cholecystectomy beginning in the era of open surgery and also in the current era of laparoscopic surgery. These studies have shown that early surgery conducted within 72–96 h after the onset of symptoms is associated with advantages such as reduced hospital stay, sick leave, and health care expenditures, and no disadvantages with regard to mortality and morbidity. Since the initial introduction of laparoscopic cholecystectomy, it has been considered to be contraindicated for acute cholecystitis. However, due to the establishment of the critical view of safety introduced by Strasberg et al. [1] for the dissection of Calot's triangle, the development of new techniques, and the improvements made to the instruments used for endoscopic surgery, laparoscopic cholecystectomy is now accepted as a safe surgical technique when it is performed by expert surgeons. Recent randomized clinical trials and meta-analyses have indicated that laparoscopic cholecystectomy is preferable to open cholecystectomy.

In 2007, the Tokyo Guidelines for the management of acute cholangitis and cholecystitis [2] were published in the *Journal of Hepato-Biliary-Pancreatic Surgery*, in which a severity classification was presented for the first time. Previously, there was no severity classification for acute cholecystitis. There were therefore no reports of the effects of surgical treatment or gallbladder drainage according to the severity of acute cholecystitis. Consequently, the treatment methods were determined based on the general opinions of professionals. Four years have passed since the publication of the Tokyo Guidelines 2007 [2], but there are still no reliable reports of the optimal treatment for each severity grade of acute cholecystitis. The therapeutic strategy for acute cholecystitis is presented here in the question-and-answer format prepared in the revision of TG07 [2] while referring to recent reports.

A. C. W. Chan
Department of Surgery, Surgery Centre, Hong Kong Sanatorium and Hospital, Hong Kong, Hong Kong

S.-T. Fan
Department of Surgery, The University of Hong Kong, Queen Mary Hospital, Hong Kong, Hong Kong

P. Jagannath
Department of Surgical Oncology, Lilavati Hospital and Research Centre, Mumbai, India

T. Mayumi
Department of Emergency and Critical Care Medicine, Ichinomiya Municipal Hospital, Ichinomiya, Japan

M. Yoshida
Clinical Research Center Kaken Hospital, International University of Health and Welfare, Ichikawa, Japan

T. Tsuyuguchi
Department of Medicine and Clinical Oncology, Graduate School of Medicine, Chiba University, Chiba, Japan

T. Itoi
Department of Gastroenterology and Hepatology, Tokyo Medical University, Tokyo, Japan

A. N. Supe
Department of Surgical Gastroenterology, Seth G S Medical College and K E M Hospital, Mumbai, India

Q1. What is the optimal surgical treatment for acute cholecystitis according to the grade of severity?

We recommend the optimal treatment according to the grade of severity as follows;
Grade I (Mild) acute cholecystitis: Early laparoscopic cholecystectomy is the preferred procedure. Grade II (Moderate) acute cholecystitis: Early cholecystectomy is recommended in experienced centers. However, if patients have severe local inflammation, early gallbladder drainage (percutaneous or surgical) is indicated. Because early cholecystectomy may be difficult, medical treatment and delayed cholecystectomy are necessary.
Grade III (Severe) acute cholecystitis: Urgent management of organ dysfunction and management of severe local inflammation by gallbladder drainage should be carried out. Delayed elective cholecystectomy should be performed when cholecystectomy is indicated.

The optimal treatment for acute cholecystitis is essentially early cholecystectomy, and the use of an established optimal surgical treatment for each grade of severity of acute cholecystitis is necessary. Early laparoscopic cholecystectomy is indicated for patients with Grade I (Mild) acute cholecystitis, because laparoscopic cholecystectomy can be performed in most of these patients. Early laparoscopic or open cholecystectomy (within 72 h after the onset of acute cholecystitis) is required in patients with Grade II (Moderate) acute cholecystitis in experienced centers, but for some patients with Grade II (Moderate) acute cholecystitis, it is difficult to remove the gallbladder surgically because of severe inflammation limited to the gallbladder. This severe local inflammation of the gallbladder is defined by factors such as >72 h from the onset, a white blood cell count >18,000, and a palpable tender mass in the right upper abdominal quadrant. Continued medical treatment or drainage of the contents of the swollen gallbladder by percutaneous transhepatic gallbladder drainage or surgical cholecystostomy is preferable, and a delayed cholecystectomy after the improvement of inflammation of the gallbladder is indicated. Among patients with Grade II (Moderate), for those with serious local complications including biliary peritonitis, pericholecystic abscess, liver abscess or for those with gallbladder torsion, emphysematous cholecystitis, gangrenous cholecystitis, and purulent cholecystitis, emergency surgery is conducted (open or laparoscopic depending on experience) along with the general supportive care of the patient. The urgent management of Grade III (Severe) acute cholecystitis is always necessary because the patients have organ dysfunction, and the simultaneous drainage of the gallbladder contents is required to treat the severe inflammation of the gallbladder. Delayed cholecystectomy is required 2 to 3 months later, after the improvement of the patients' general condition when cholecystectomy is indicated.

Q2. Which surgical procedure is preferred, laparoscopic cholecystectomy or open cholecystectomy?

We recommend that laparoscopic cholecystectomy is preferable to open cholecystectomy (recommendation 1, level A).

Gallstones are one of the major causes of acute cholecystitis, and cholecystectomy is now being carried out in many of the patients with cholecystolithiasis. Until the first half of the 1990s, there were opinions that laparoscopic surgery was not indicated in patients with acute cholecystitis [3]. Open cholecystectomy was the standard technique. However, more recently, laparoscopic surgery has also been introduced for acute cholecystitis, and is now generally considered to be the first option for surgery, similar to open cholecystectomy. Several reports, including randomized controlled trials (RCTs) comparing laparoscopic cholecystectomy and open cholecystectomy, have indicated that laparoscopic cholecystectomy is associated with a significantly shorter postoperative hospital stay and a lower incidence of complications [4–7]. A meta-analysis has also shown that laparoscopic cholecystectomy not only resulted in treatment effects similar to those produced by open cholecystectomy, but that it is also a useful surgical procedure in terms of its low mortality and morbidity[8, 9]. However, the above reports have failed to examine its use for acute cholecystitis according to the grade of severity. Laparoscopic cholecystectomy is not recommended for all cases of acute cholecystitis due to the possibility of patients in whom cholecystectomy is difficult because of severe inflammation [10].

On the other hand, there has been a change in the perioperative management of open cholecystectomy patients in the last few years, and the current management aims to reduce postoperative pain and encourage early ambulation and early discharge. These changes show that, in terms of the postoperative course, open cholecystectomy with mini-incision is able to produce as good results as those obtained by laparoscopic cholecystectomy, although the superiority of laparoscopic cholecystectomy as a surgical technique for acute cholecystolithiasis can be recognized [8, 9]. In fact, a RCT was carried out to reappraise the use of laparoscopic cholecystectomy and open cholecystectomy by a subcostal muscle transection incision [11]. This study indicated that no significant differences were observed between the two types of cholecystectomies with regard to the rate of postoperative complications, the degree of pain at discharge, the duration of sick leave, and the direct medical

cost. At the moment, laparoscopic cholecystectomy is comprehensively preferred as the surgical treatment for acute cholecystitis. However, the first priority is the safety of the patients. With this in mind, open surgery can be considered to be as effective as laparoscopic surgery.

A cohort study was carried out in a total of approximately 30,000 patients with acute cholecystitis aged 66 years or older concerning the surgical procedures for acute cholecystitis; 75 % of those patients underwent cholecystectomy at the time of the initial hospitalization, with 71 % undergoing laparoscopic cholecystectomy and 29 % undergoing open surgery. The results of the analysis showed that laparoscopic cholecystectomy is being used as the first option for surgical procedures that can be performed urgently for acute cholecystitis [12].

Q3. What is the optimal timing of cholecystectomy for acute cholecystitis?

We recommend that it is preferable to perform cholecystectomy soon after admission, particularly when less than 72 hours have passed since the onset of symptoms (recommendation1, level A).

With regard to the timing of the surgery for acute cholecystitis, there are several reports of RCTs conducted in the 1970s and 1980s that compared early surgery and elective surgery (from the initial onset until 4 months later) by open cholecystectomy. The trials failed to find a difference between the surgical procedures in terms of the amount of bleeding, duration of surgery, and incidence of complications; however, they were able to show that early surgery is preferable because it reduces the hospital stay and leads to an early cessation of pain in the patients [12–17]. In recent years, laparoscopic cholecystectomy has been actively used for acute cholecystitis and the rate of its use has been increasing every year since its introduction [18]. The usefulness of early surgery (rather than delayed surgery) has been indicated in RCTs [19–21] and in meta-analyses in patients with acute cholecystitis [22–25]. However, the definition of early surgery differed in each report, because there were different starting times for the operations, such as onset of symptoms, time of diagnosis, and use of randomization. Early surgery was mainly conducted within 72–96 h from onset of symptoms. On the other hand, elective surgery was performed 6 weeks or more after the onset. Thus, the results of several reports indicated with a high level of evidence that laparoscopic cholecystectomy performed during the first admission was associated with a shorter hospital stay, quicker recovery, and reduction in overall medical costs compared to open cholecystectomy. Early laparoscopic cholecystectomy is now accepted to be sufficiently safe for routine use.

After evaluating a patient's overall condition and confirmation of the diagnosis by ultrasonography, computed tomography (CT), and/or magnetic resonance cholangiopancreatography, the timing of the surgical management of acute cholecystitis patients should be decided by experienced surgeons. Unfortunately, early surgery is performed less frequently than is recommended at present because of the scarcity of surgeons [18, 26, 27]. However, the fact that the above trials excluded patients with pan-peritonitis caused by perforation of the gallbladder, patients with common bile duct stones, and those with concomitant severe cardiopulmonary disease should be kept in mind when evaluating the results of these trials.

Additionally, each meta-analysis indicated that there was no statistically significant difference in the incidence of bile duct injury (BDI). However, these meta-analyses did not include a large enough number of patients to detect a difference, because the incidence of BDI in the laparoscopic era is generally less than 1.0 % [28–30]. Therefore, it is impossible to assert that there are no significant differences in the incidence of BDI on the basis of its frequency in these meta-analyses.

Q4. When is the optimal time for conversion from laparoscopic to open cholecystectomy?

We recommend that surgeons should never hesitate to convert to open surgery to prevent injuries when they experience difficulties in performing laparoscopic cholecystectomy (recommendation 1, level C).

There is a relatively high rate of conversion from laparoscopic cholecystectomy to open cholecystectomy for acute cholecystitis because of technical difficulties, and laparoscopic cholecystectomy is associated with a high complication rate [10, 31]. Although preoperative factors such as male gender, previous abdominal surgery, the presence or history of jaundice, advanced cholecystitis, and infectious complications are associated with a need for conversion from laparoscopic to open cholecystectomy, they have limited predictive ability [32–34]. Surgeons assess patients using various factors when deciding whether or not conversion to open cholecystectomy, particularly during laparoscopic cholecystectomy, is necessary. Therefore, experience not only of the individual surgeons, but also of the institution where the laparoscopic cholecystectomy is conducted, is required to successfully perform cholecystectomy for all patients with acute cholecystitis.

The critical view of safety described by Strasberg et al. [1] in 1995 is of the utmost importance (Fig. 1). Above all, this critical view is now the ultimate principle for

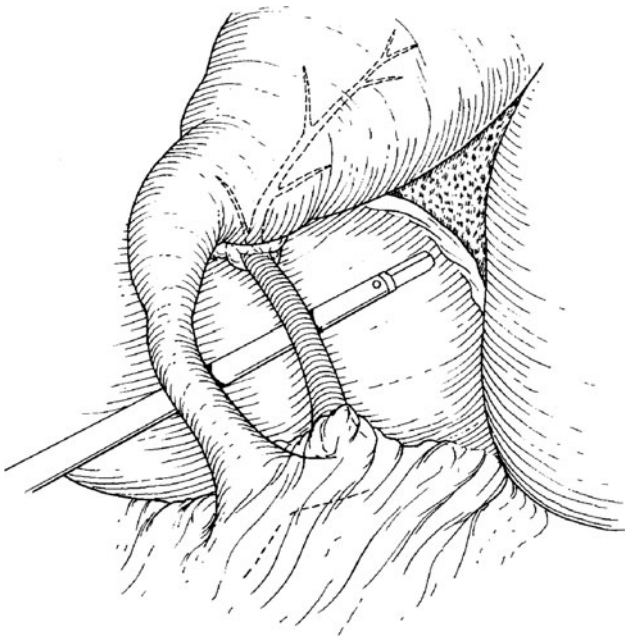

Fig. 1 Creation of a critical view of safety. Calot's triangle is dissected free of fat and fibrous tissue and the lower end of the gallbladder is dissected off the liver bed. It is not necessary to expose the common bile duct. The critical view of safety is now the ultimate standard to prevent BDI during laparoscopic cholecystectomy. Failure to create this view is an indication for conversion to open cholecystectomy

preventing BDI during laparoscopic cholecystectomy, and involves conclusive identification of the indicated structures by dissection in Calot's triangle. Surgeons who failed to create this surgical view should consider which procedure is more appropriate for conversion to define the bile duct anatomy, i.e. conversion to open cholecystectomy or intraoperative cholangiography.

Since conversion to open cholecystectomy to prevent intraoperative accidents and postoperative complications is not disadvantageous for patients, surgeons should never hesitate to perform such a conversion when they experience difficulty while performing laparoscopic cholecystectomy. A low threshold for the conversion to open cholecystectomy is important to minimize the risk of major complications.

Q5. When is the optimal time for cholecystectomy following PTGBD?

The optimal time, however, remains controversial due to a lack of any strong evidence.

There have been no randomized controlled trials that have examined the surgical management of patients with acute cholecystitis undergoing percutaneous transhepatic gallbladder drainage (PTGBD). However, PTGBD is known to be an effective option in critically ill patients, especially in elderly patients and patients with complications. Cholecystectomy is often performed following PTGBD after an interval of several days [35, 36]. However, performing a cholecystectomy 2 weeks later is also common [37]. Overall, early cholecystectomy following PTGBD is preferable when the patient's condition improves, and if the patient has no complications. Complications of PTGBD sometimes occur, such as intrahepatic hematoma, pericholecystic abscess, biliary pleural effusion, and biliary peritonitis, which may be caused by puncture of the liver and the migration of the catheter. However, such migration should be prevented. On the other hand, PTGBA (percutaneous transhepatic gallbladder aspiration) is often used by many facilities, and produces good treatment outcomes. However, a RCT indicated that PTGBD was superior to PTGBA in terms of its clinical effectiveness [38].

Q6. What are the complications to be avoided that are associated with laparoscopic cholecystectomy?

Bile duct injury, bleeding, and the injury of other organs (level C).

Complications of laparoscopic cholecystectomy were reported soon after its introduction, and include BDI, intraperitoneal hemorrhage needing laparotomy, bowel injury, and hepatic injury, as well as the commonly observed complications associated with conventional open cholecystectomy, such as wound infection, ileus, atelectasis, deep vein thrombosis, and urinary tract infection. Bile duct injury is considered to be a serious complication. Bowel and hepatic injuries should also be carefully avoided as serious complications [28]. These injuries have been attributable to the limitations of laparoscopic procedures, such as the narrow view and non-tactile manipulation. Laparoscopic cholecystectomy is not always associated with a higher incidence rate compared with open cholecystectomy [30–32], but any serious complication that requires re-operation and/or prolonged hospitalization may become a serious problem for patients, even those who firmly believe that laparoscopic cholecystectomy is less invasive. In spite of many improvements in the technique and equipment, as well as the surgeon's learning curve, the BDI rate remains high compared to open cholecystectomy. Table 1 shows the laparoscopic BDI rates in Japan from biannual questionnaire surveys performed by the Japan Society of Endoscopic Surgery (JSES) [28]. The incidence of BDI in the laparoscopic era is higher than that in the open cholecystectomy era, and is consistently around 0.6 %. Because of this rate, if a RCT is planned, two arms

Table 1 The complications of laparoscopic cholecystectomy in Japan [28, 48]

	1990–2001	2002	2003	2004	2005	2006	2007	2008	2009
BDI rate (%)	0.66	0.79	0.77	0.66	0.77	0.65	0.58	0.54	0.62
Organ injury (%)	0.25	0.43	0.17	0.17	0.22	0.14	0.14	0.20	0.20
Bleeding (%)	0.65	0.72	0.72	0.72	0.69	0.56	0.58	0.52	0.55
No. of LCs	176,294	19,557	19,084	19,067	20,203	21,550	22,599	25,174	26,140

Japanese annual rates of bile duct injury, organ injury and bleeding to need laparotomy caused by laparoscopic cholecystectomy are shown

LC laparoscopic cholecystectomy

consisting of thousands of patients are required to detect bile duct injury. There has been no RCT consisting of such a large number of patients in individual arms. Even the arms of the meta-analyses of RCTs were not large enough to detect a difference. Therefore, it is possible that large population studies would suggest that there are some severe complications caused by laparoscopic cholecystectomy, whereas smaller studies do not indicate those problems.

We therefore performed an extensive search of the literature for all types of bile duct injury. The most extreme bile duct injury seems to be a vasculobiliary injury involving the major hepatic artery and portal vein. The incidence of extreme vasculobiliary injury is approximately 2 % of the patients who sustain major biliary injuries requiring surgical reconstruction during laparoscopic cholecystectomy [39]. Such an extreme vasculobiliary injury is more likely to occur when fundus-down cholecystectomy is attempted in the presence of severe inflammation of the gallbladder, usually after the conversion from laparoscopic to open cholecystectomy. This injury is caused by dissection behind the cystic plate into the right portal pedicle. To prevent such an injury, the surgeon involved should recognize the features of severe inflammation, particularly severe contractive inflammation, and refrain from using the fundus-down technique when these symptoms are present.

Q7. When is the optimal time for cholecystectomy following endoscopic stone extraction of the bile duct in patients with cholecysto-choledocholithiasis?

No definitive conclusions could be made due to the insufficient evidence.

Combining endoscopic stone extraction (ESE) with laparoscopic cholecystectomy during endoscopic retrograde cholangiography has been found to be a useful means of treating patients with cholecysto-choledocholithiasis. However, the optimal timing of laparoscopic cholecystectomy following ESE is still a matter of controversy in patients with acute cholecystitis. There have been several reports including meta-analysis on combinations of ESE and laparoscopic cholecystectomy for patients only without acute cholecystitis. A meta-analysis report showed that intraoperative endoscopic sphincterotomy is as effective and safe as postoperative endoscopic sphincterotomy and resulted in a significantly shorter hospital stay [40], and there were some reports which mentioned that the interval between the two procedures was a few days [41–44]. The interval between ESE and laparoscopic cholecystectomy is therefore left to the individual surgeon. At the moment, early laparoscopic cholecystectomy following ESE during the same hospital stay is preferable in some patients without complications related to ESE.

A report of an analysis of approximately 30,000 patients who were urgently admitted or admitted through the emergency department for acute cholecystitis demonstrated that a lack of definitive therapy was associated with a 38 % gallstone-related cumulative readmission rate over the subsequent 2 years [12]. This report also demonstrated that patients with acute cholecystitis were more likely to have gallstone-related readmission than patients who had common bile duct stones. However, common bile duct stones are undoubtedly one of the factors predicting readmission, including gallstone-related pancreatitis [45–47]. Therefore, obtaining informed consent concerning readmission is indispensable for the possible risk for those patients who did not undergo cholecystectomy during the initial hospitalization.

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Conflict of interest None.

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