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REVIEW RADIOLOGY

Percutaneous cholecystostomy: An update for the 2020s

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ABSTRACT

Cholecystectomy is the standard treatment of acute cholecystitis. Surgery, however, poses significant risks for patients with advanced age and/or comorbid conditions. For such patients, percutaneous cholecystostomy (PC) is the only option. This interventional procedure does not have any absolute contraindications because of the life-threatening nature of the disease, in which other treatment options cannot be offered due to their risks. Nonetheless, these risk factors necessitate performing PC under urgent, rapid, and in many cases suboptimal conditions. In this article, PC was revisited in the light of our extensive experience in addition to the most current literature. Pre-procedural evaluation including the risk assessment and procedural steps was presented in detail. If conducted properly, PC provides significant clinical improvement in the short term and is life-saving, especially in the elderly and in patients with comorbid diseases or high surgical risk. It may also be the definitive treatment method for acute cholecystitis.

Keywords: Cholecystitis; cholecystostomy; gallbladder; interventional procedure.

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Acute cholecystitis is a common disease with significant risk of morbidity and mortality, especially in cases in poor general condition [1]. The standard and definitive treatment of this disease is laparoscopic cholecystectomy [2]. Open surgery is only reserved for cases with severe inflammation and fibrosis [3]. Surgery, whether open or laparoscopic, poses a significant risk to patients with advanced age and/or comorbid conditions [4]. Both of these factors are present in the majority of patients with acute cholecystitis. For such cases, percutaneous cholecystostomy (PC), aside from temporizing the patient, is the only method that can be used to prevent major complications of acute cholecystitis which includes empyema, gangrene, perforation, or sepsis [5, 6]. Recently, it has also been speculated that PC may provide definitive and final treatment in certain cases [7, 8]. For many others, it may even serve as a bridge to surgery [9, 10].

PC does not have an absolute contraindication because of the life-threatening nature of the disease, in which other treatment options cannot be offered due to their risks [6]. Apart from constituting indications, the emergency nature of the situation and poor general status of patients urge physicians to perform PC urgently, rapidly, and in many cases under suboptimal conditions. Nevertheless, the clinical benefit of the procedure is equally rapid and significant even under such terms. These benefits depend on fast but detailed evaluation of risk factors and strict adherence to the technique as presented below.

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PATIENT SELECTION

Indications

The general indications for PC include: (i) Presence (in this context, radiological diagnosis) of acute cholecystitis in patients with temporary or permanent problems that may interfere with surgery including hydropic gallbladder in addition to clinical findings of cholecystitis, (ii) inability to catheterize intrahepatic biliary tract during percutaneous biliary drainage despite a reasonable number of attempts, and (iii) empiric cholecystostomy due to fever of unknown origin [5].

Contraindications

The primary indication of PC is the presence of a surgical contraindication that prevents surgery. Therefore, the method has no absolute contraindication. The only exception is intestinal interposition, which may prevent access by obstructing the trajectory [11]. The presence of ascites on the access route or presence of massive gallstones that prevent the formation and locking of the catheter's loop is among relative contraindications. Although coagulopathy and/or the use of antiplatelets and/or anticoagulants are relative contraindications, a recent study of 132 coagulopathic and 110 normal patients who underwent ultrasound-guided PC reported that there was no difference in terms of major and minor complication rates [12].

PRE-PROCEDURAL EVALUATIONS

All patients should have prior physical and radiological examinations, including ultrasonography (USG) and/or computed tomography. They should be graded and classified according to Tokyo Guidelines 2018 for acute cholecystitis (TG18).

TG18 provides a severity grading for acute cholecystitis to objectively guide the management of patients in terms of early or delayed surgical intervention, early or delayed gallbladder drainage, antibiotic choice, and duration [3]. The guidelines recommend the use of CCI [13] and ASA [14] scores to further classify patients as low-risk or high-risk surgical candidates.

CCI was originally developed to predict long-term survival in patients with multiple comorbidities in outcomes research from administrative databases, but it may still provide a simple indicator in certain disease with short life expectancy [15].

Highlight key points

- Cholecystectomy, whether open or laparoscopic, poses significant risk to patients with advanced age and/or comorbid diseases. Both of these factors are present in the majority of patients with acute cholecystitis.
- In such cases, PC is the only method that can be used to prevent major complications of acute cholecystitis and may be life-saving.
- PC does not have an absolute contraindication due to the life-threatening nature of the disease, when other treatment options cannot be offered due to their risks.
- The low recurrence rate after the procedure makes PC the final and definitive treatment for acute cholecystitis in selected cases. For many others, it may serve a bridge to surgery.

In the context of the above-mentioned classification systems, primary and secondary (i.e., comorbid or confounding) factors that may influence the course and the outcome of the treatment (i.e., for TG18: Cardiovascular, neurological, respiratory, renal, hepatic, and/or hematological dysfunction, elevated white blood cell (WBC) count, palpable tender mass in the right upper quadrant, duration of complaints >72 h, marked local inflammation; and for CCI: Age of ≥50 years, myocardial infarction, congestive heart failure, peripheral vascular disease, cerebrovascular accident or transient ischemic attack, dementia, chronic obstructive pulmonary disease, connective tissue disease, peptic ulcer disease, liver disease, diabetes mellitus, hemiplegia, chronic kidney disease, sold tumor, leukemia, lymphoma, and AIDS) must be recorded.

PROCEDURAL STEPS

Guidance Method and Patient Position

The procedure is best performed under USG guidance using a multiband convex array transducer. Fluoroscopy, as an adjunct to USG, may be used when appropriate. Ideally, patients should be positioned in the left semi-lateral decubitus position, except for bedside procedures in the intensive care unit. An operating table is preferred to place the patient in the most appropriate position for the procedure. If such a table is available, it should be flexed so that the upper portion of the trunk slightly extended from the table's center break and the lower part of the trunk is completely in the Trendelenburg position to broaden lower intercostal distances and to expose the region of interest.

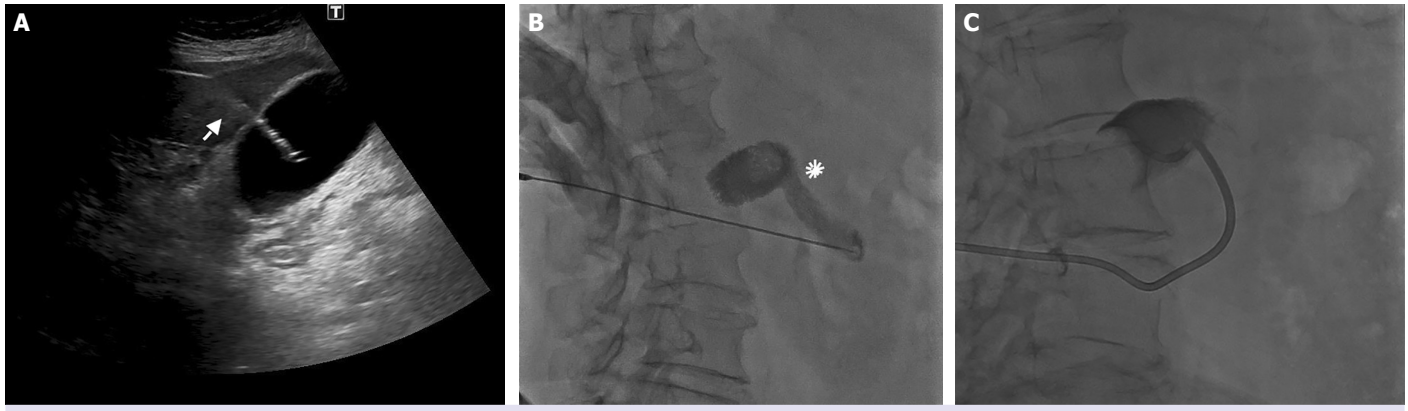

FIGURE 1. Ultrasound-guided transhepatic entrance of 18 G trocar type needle (arrow) in percutaneous cholecystostomy **(A)**. After the initial entry, 10 ml bile was aspirated and 5 ml of nonionic contrast agent was injected into the lumen under the fluoroscopic guidance (*) **(B)**. An 8 F pigtail drainage catheter was placed over the guide wire under fluoroscopic guidance after tract dilatation **(C)**.

Pre-procedural Prophylaxis and Disinfection

Intravenous (IV) access should be established before referral and a second-generation cephalosporin (e.g., cefuroxime) should be administered for Gram-negative bacteria. IV sedatives may not be applied because of the procedure's short duration and to minimize traumatization in experienced hands. The entry site should be cleaned with 7.5% povidone-iodine from the axillary to the iliac crest level and covered to prevent surgical site infection.

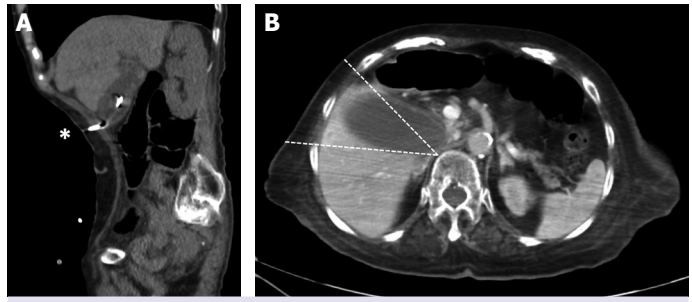

FIGURE 2. **(A)** Transperitoneal (*) percutaneous cholecystostomy in cachexia and irregular respiration prevented the visualization of optimal ultrasonography for guidance. **(B)** Approach zone in percutaneous cholecystostomy (white lines). The entry was accomplished from a zone that is located between the right mid-axillary and right mid-clavicular lines.

Invasive Steps

The transhepatic approach is preferred in almost all cases (Fig. 1a–c). The transperitoneal approach is preferred only in cases where the transhepatic approach is impossible and in patients with severe liver disease (Fig. 2a) [15]. The former is attempted using intercostal entry between the right mid-axillary and mid-clavicular lines (Fig. 2b) [11, 16]. With this approach, the segment 5 and segment 6 of the liver are generally traversed before reaching the gallbladder. At least 10 mm parenchyma should be advanced to secure the catheter and to prevent leakage. An injection of 10 ml of local anesthesia should be made to the subdermal trajectory and around the liver capsule. The Seldinger method is used in the next step. Single-step catheterization should be avoided to prevent potential rupture of the distended and fragile gallbladder wall. A standard 15–20 cm and 18 G trocar type needle may be used for the entrance. Approximately 10 ml bile should immediately be aspirated to prevent bile leakage during subsequent dilatation and microbiological analyses. In cases in which the procedure is conducted on a fluoroscopy table, 5 ml of non-ionic iodine contrast agent is injected into the lumen (Fig. 1b). A 90 cm long super-stiff guide wire is gently advanced into the lumen only enough to advance the catheter into the gallbladder. A full loop should not be formed to avoid creating excessive tension on the gallbladder wall. This wire should be rigid enough to support the drainage catheter but soft enough to form a partial loop within the gallbladder [11]. Then, the access tract is dilated using 6 and 8 F fascial dilators. In the final step, an 8 F pigtail drainage catheter is advanced through the guide wire to the gallbladder lumen using catheter's metal stiffener. The metal stiffener is held continually to prevent the catheter from being pulled back and the catheter is advanced to form a loop in the lumen. After verifying the intraluminal presence of the loop, the catheter is fixed to the skin with sutures (Fig. 1c). To prevent intraluminal hemorrhage,

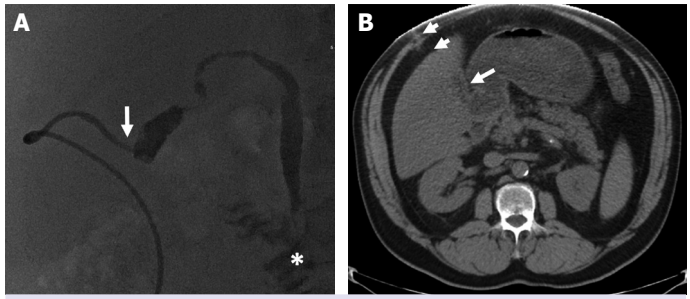

Figure 3. T Removal of cholecystostomy catheter after tract maturation. At 6 weeks, **(A)** contrast agent does not leak out and passes into the duodenum (*). Two months later, computed tomography **(B)** shows a heterogeneous sequela of the catheter tract (short arrows) and normal shrunken gallbladder (long arrow).

the gallbladder is not aspirated, but left to free drainage, except in select cases with severe biliary colic or excessive sludge formation. Another method used in PC is the trocar. In this technique, the catheter is inserted directly into the gallbladder. Although this may increase the risk of hemorrhage, this procedure has relatively less steps.

Follow-up

Ideally, patients are clinically and radiologically assessed 3 days, 1 week, 4 weeks, and 6 weeks after the procedure. On the 3rd day, the clinical efficacy of the procedure is assessed with clinical and laboratory findings including WBC count [17]. Position of the catheter and its mechanical efficacy in decompression is verified with ultrasound on the 1st week and 4th week. Catheters are clamped during the latter examination and are withdrawn at 6 weeks under fluoroscopy after evaluating cystic duct patency and tract maturity (Fig. 3a, b).

CLINICAL AND RESEARCH CONSEQUENCES

Early laparoscopic cholecystectomy within a week is recommended for low-risk candidates. However, for high-risk candidates, PC should be considered. PC is performed with a relatively standard technique and therefore, technical success is achieved in almost 95% of cases [18, 19]. According to the Society of Interventional Radiology, the recommended technical success threshold of PC is 97.9% [20]. This rate may be further improved if the proceeding of hydropic gallbladder to PC is radiologically confirmed. Another positive factor is the presence of favorable physical settings and an experienced team for non-vascular radiology.

The clinical success rate is more variable than the technical success rate. This variability is most likely due to the differences in study cohorts and the use of different sets of criteria for clinical success [11]. Most acknowledged criteria are the resolution of pain, fever, and inflammatory markers (WBC, C-reactive protein) 48–72 h after the insertion of PC catheters [21], WBC being the main marker that is being preferred by most researchers [17]. WBC count is also a more objective finding. The clinical success rate was reported to range from 60% to 90%, according to various studies [22, 23]. A systematic review has previously demonstrated successful clinical response in 85.6% of patients undergoing PC for classic acute cholecystitis [23]. The clinical success rate reported in the literature ranges between 85.6% and 97.5%, with a proposed threshold of 74.2% [24–26].

As PC candidates generally have poor clinical status, they often succumb to comorbid diseases despite the actual technical success [1]. It may not always be possible to differentiate deaths due to cholecystitis from other causes of deaths, and it may be impossible to evaluate clinical success due to patient demise. However, only a few patients die in the first 30 days following PC and very few die from sepsis, due to absolute inefficacy of the procedure. In fact, the best clinical results reported in the literature were of patients with a recent clinical and radiological diagnosis of acute cholecystitis [18, 19]. In a systemic review of 53 studies consisting of 1918 patients, 30-day mortality was analyzed into three groups as total, biliary, and procedural mortality. Biliary mortality was defined as deaths due to cholecystitis and procedural deaths such as bowel perforation, leakage, or bleeding. Rates for mortality caused by biliary infection were 3.6% and the mortality rate for deaths associated with the procedure itself was 0.36%. The overall mortality was 15.4% [24]. In the aforementioned review, although the 30-day mortality after PC was high (15.4%), the procedural mortality was very low (0.36%). The 30-day mortality rates reported in the literature have a rather wide range (8%–36%). According to various studies, the mean mortality rate directly related to the procedure is 0.35%, ranging between 0% and 0.36% [24–26].

PC is usually a low-risk procedure and the complication rate is between 0% and 9% [27]. Major complications included sepsis (3.5%–5%), major hemorrhage 0.90% (0.69%–1.4%), and bowel injury (0.35%–1.4%). Minor complications included catheter dislodgment (7%–7.6%), bile leak (2.8%), catheter blockage (7%–7.5%), and minor hemorrhage (1.2%) [24–26]. The most common

complication reported in previous studies were catheter dislodgement and blockage. Adequate locking and fixing of the pigtail catheter may reduce this risk. Biliary leakage during catheter insertion and removal is due to the fragility of the inflamed gallbladder wall, caused by manipulations during the initial entry, directly, or due to mechanical pressure of the catheter on the gallbladder wall [16, 28]. Bile leakage can also occur during catheter removal and has been reported as 3% in the literature [28]. However, it should be kept in mind that even in such cases, the bile leakage is usually self-limiting and does not require further treatment. However, larger leaks may cause bilioma, where additional drainage is appropriate. Minor hemorrhage into the gallbladder is another minor complication and is usually due to rapid decompression of the fragile gallbladder. This complication is usually self-limiting and its treatment is attempted by temporarily clamping the catheter to provide a tamponade. Pleural or intestinal perforation and peritonitis due to bile leakage and sepsis are very rare complications and are encountered in only 0.35–1.4% of cases [20]. They may be prevented in many if not all cases by adopting a transhepatic approach to avoid these structures. The transhepatic approach has many additional advantages such as providing an extended route to support drainage catheter, and preventing bile leakage due to the shrinkage of the decompressed gallbladder away from the catheter toward its bed [11]. However, the difference between two methods is insignificant in terms of bile leakage [16]. Another advantage of the transhepatic approach is that it provides a straightforward and non-motile approach to the relatively small gallbladder. Nevertheless, most cases with acute cholecystitis have large and immobilized gallbladders. The final advantage of the transhepatic approach is rapid tract maturation that may allow shorter catheterization. Adjacent structures may be perforated if anatomical structures are not fully evaluated before or during the PC or if the patient cannot be optimally positioned during the procedure. This may result in inadvertently traversed pleural space or large bowel lumen [11]. In such an event, primary repair can be performed or the catheter may be removed during the procedure or left in place to ensure the formation of tract maturation and controlled fistula [11]. In case of pleural catheterization, the transpleural catheter must be immediately removed to prevent bile-induced pleural reaction. However, in a recent study, 218 PC catheters were inserted with the transhepatic approach and 153 were inserted with the transperitoneal approach. There was no difference in outcomes between the two approaches [29].

PC may serve as the bridge to laparoscopic or open surgical treatment when a temporary definitive treatment cannot be provided [5, 6]. According to several studies, it is also a safe and definitive treatment in patients with high surgical risk [9]. In these studies, the rate of patients that did not require an additional cholecystectomy ranged from 43% to 94% [30, 31]. For instance, Leveau et al. [31] reported a subsequent cholecystectomy in two out of 26 patients. According to another recent study, only 10 out of 71 patients required a subsequent cholecystectomy, reporting PC as definitive treatment in 86% of patients [32].

Conclusion

PC provides significant clinical improvement in the early term and is a life-saving procedure, especially in elderly patients and in patients with comorbid diseases or high surgical risk. The low recurrence rate after the procedure makes PC the definitive treatment method for acute cholecystitis in selected cases. The procedure has a very low complication rate when performed in experienced centers, and does not have an absolute contraindication.

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