Ultrasound-guided percutaneous cholecystostomy in acute cholecystitis: case vignette and review of the technique

Pablo A. Blanco¹ · Juan J. Do Pico²

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Abstract Acute cholecystitis is a frequent condition. Although cholecystectomy is the indicated treatment of this entity, it cannot be performed in some high-risk surgery patients, such as critically ill or those with multiple comorbidities. In these non-uncommon scenarios, percutaneous cholecystostomy is the recommended alternative treatment, which allows immediate decompression and drainage of the acutely inflamed gallbladder and thus reducing the patient's symptoms and the systemic inflammatory response. Ultrasound is the imaging method of choice to guide the percutaneous cholecystostomy procedure due to its real-time guidance, lack of ionizing radiation and portability, avoiding the need to transfer unhealthy patients to the radiology department. We will review the ultrasound-guided percutaneous cholecystostomy procedure, of special interest for radiologists, surgeons, and also intensive care and emergency physicians.

Keywords Acute cholecystitis · Interventional radiology · Ultrasonography · Cholecystostomy

Sommario La colecistiti acuta é una malattia frequente. Benché la colecistectomia laparotomica sia una procedura validata essa non è idonea nella popolazione ad alto

rischio, quali i pazienti critici o quelli con elevate comorbidità. In tali categorie il trattamento percutaneo é la procedura suggerita consentendo di decomprimere la colecisti e ridurre i sintomi sirs correlati. La metodica eco assistita real time e la procedura di scelta in considerazione della assenza di radiazioni e la facilitadi esecuzione in ambiti extra radiologici. Descriveremo di seguito la tecnica di colecistostomia eco guidata di interesse radiologico, chirurgico e rianimatorio.

Introduction

Acute cholecystitis (AC) is a common condition, with early cholecystectomy in addition with antibiotic therapy considered the reference treatment for its management [1, 2].

Cholecystectomy carries low complication rates in patients suitable for general anesthesia and surgery. However, cholecystectomy being performed for acute calculous or acalculous cholecystitis conveys significant morbidity and mortality rates in high-risk surgical patients, such as elderly patients or those critically ill or with multiple comorbidities [3]. The morbidity and mortality rate in these subgroups may reach up to 30 % [1–3]. Therefore, more appropriate treatment modalities for high-risk patients with AC should be considered [4]. At respect, management with antibiotics and decompression of the gallbladder with percutaneous cholecystostomy (PC) is often used in treating this group of patients [3, 4].

Percutaneous cholecystostomy represents the treatment chosen for 1.5 % of patients suffering from calculous cholecystitis and 7.4 % of those with acalculous cholecystitis [2].

Percutaneous cholecystostomy is a minimally invasive image-guided intervention performed under local

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✉ Pablo A. Blanco
ohtusabes@gmail.com

¹ Intensive Care Unit, Hospital Dr. Emilio Ferreyra, 4801, 59 St., 7630 Necochea, Argentina

² Department of Surgery, Hospital Dr. Emilio Ferreyra, Necochea, Argentina

anesthesia consisting in the placement of a catheter in the gallbladder lumen with the purpose of decompressing the gallbladder, reducing the patient's symptoms and the systemic inflammatory response [1]. Image guidance for PC is achieved using ultrasound, fluoroscopy, or computed tomography [1]. Ultrasound guidance is the most common and is performed at the bedside avoiding the need to transfer of patients to the operating room or radiology department [1, 3].

Case vignette

A 72-year-old man with history of arterial hypertension, ischemic cardiomyopathy, and chronic severe aortic regurgitation was admitted to the intensive care unit with hemodynamic instability expressed as tachycardia and arterial hypotension, fever (38.7 °C), abdominal pain, and vomiting lasting one-day and altered mental status. On examination, the patient was obtunded, pale, and with a poor peripheral perfusion. A tense and tender mass was found in the right upper quadrant. A white blood count of 13,000 per mm³ (80 % neutrophils) was the remarkable data on laboratory tests. An abdominal ultrasonography was performed at the bedside and revealed a distended gallbladder measuring 52 mm in transverse diameter with thickened walls, measuring 8 mm. Hypoechoic regions were evident within the gallbladder wall. Biliary sludge was also present; gallstones were absent. The diagnosis of acute acalculous cholecystitis was made based on clinical and ultrasonographic findings. After endotracheal intubation and fluid resuscitation, a transhepatic PC was performed at the bedside under real-time ultrasound guidance (Fig. 1 and Video 1). A modified Seldinger technique was used to place a 10-French locking pigtail multipurpose catheter into the gallbladder. There was no evidence of procedure-related complications. A black and thick bile was obtained from gallbladder drainage. Intravenous ampicillin–sulbactam was also added to treatment. His evolution was uneventfully and was discharged from hospital at day 20. Gallbladder drainage was removed at day 30, and no need of cholecystectomy was evident 6 months later.

Percutaneous cholecystostomy and its role in management acute cholecystitis

The definite and recommended treatment of AC is cholecystectomy [1–3]. Alternative treatment options in patients unsuitable for surgery are PC and EUS-guided transgastric/transduodenal gallbladder drainage [2, 5, 6]. Excluding patients with limited life expectancy caused by advanced malignancy or in rare circumstances when PC is

contraindicated, PC is considered the treatment of choice for patients who are not candidates for cholecystectomy [2, 5, 6]. PC has been shown to be lifesaving in high-risk patients [7] and should be considered a reasonable option in the therapeutic spectrum for patients with both acalculous and calculous AC as a temporizing measure while awaiting resolution of sepsis and optimization of comorbidities before performing the elective surgery or also as a definite treatment, especially in acalculous forms [7–9]. PC seems especially useful for certain categories of patients such as patients in intensive care (where the prevalence of acalculous cholecystitis can be as high as 10 %) and in pregnant women where medical treatment alone for cholecystitis is often not successful [2].

The recurrence rate of cholecystitis after nonsurgical treatment is significantly lower in acalculous AC patients in comparison with patients with calculous cholecystitis [9, 11, 12].

The reported success rate of PC is high (approximately 85 %) and the complications are low (about 10 %) [1, 2, 8].

Ultrasound-guided percutaneous cholecystostomy

Technical aspects

PC is usually performed at the bedside under real-time ultrasound guidance (US-PC), best achieved using a convex probe at a frequency range of 2.5–6 MHz. A sector probe (2–5 MHz) is preferable for an intercostal approach [1]. Fluoroscopy and computed tomography can also be used as a guidance to cholecystostomy; however, their use are problematic due to limited availability, higher costs, ionizing radiation and, of no minor importance, the need to transfer “unhealthy” patients to the radiology department.

US-PC is performed under local anesthesia typically by an interventional radiologist or a surgeon [1, 2]. Is probably that in the near future, some other physicians trained in both diagnostic and interventional ultrasound (such as intensivists or emergency physicians) will also perform routinely the US-PC.

The gallbladder is evaluated using US and the safest access route is chosen, which can be transhepatic or transperitoneal [1, 2] (Fig. 2). US guidance is also used to monitor the procedure. The patient lies supine and after skin asepsis and subcutaneous lidocaine is administered, the puncture is performed.

Anatomically, the gallbladder is an extraperitoneal organ, normally lying at the bare area of the liver [1]. The transhepatic route (extraperitoneal) aims to pass the catheter via the bare area of the liver in order to access the gallbladder. A transhepatic approach may reduce the risk of bile leak, provide greater catheter stability, and quicker

Fig. 1 Ultrasound-guided transhepatic percutaneous cholecystostomy. Modified Seldinger technique. **a** Needle path (arrows), asterisk: duodenum; **b** The needle is within the gallbladder (arrows), asterisk: duodenum; **c** After guidewire is advanced into the gallbladder and tract dilation, the pigtail catheter is inserted (arrows); thereafter, the guidewire is removed and the gallbladder is finally emptied, asterisk: duodenum

Fig. 2 Illustration showing in **a** transhepatic access in subcostal (1) and intercostal (2) approach and in **b** transperitoneal access (3)

tract maturation [1, 2]. Ideally the puncture site should be subcostal, but if an intercostal approach is required, special care needs to be taken to avoid entering into the pleural space (the diaphragm is the most important reference landmark) and also to avoid the intercostal neurovascular bundle, passing inferior to the rib [1].

The transperitoneal route can be used when the transhepatic route is impossible for anatomical reasons, or in case of liver disease or coagulation disorders [1, 2], as long

as the gallbladder is distended, and is nearest to the abdominal wall [2]. However, coagulation disorders should be considered as a relative contraindication to perform a transhepatic approach since no differences have been found in the complication rate of US-PC in patients who are coagulopathic compared with those who have normal coagulation [3].

Two techniques are used for the placement of the pigtail catheter into the gallbladder: the modified

Seldinger technique and the trocar technique. The modified Seldinger technique (multiple-step technique) consists of inserting a fine needle (e.g., 18 gauge) into the gallbladder. A 0.035-inch J-tip guidewire is then inserted, over which increasing diameters of dilators can be inserted to dilate the tract to a size 1 French (F) larger than intended drainage catheter (normally a 7- to 10-F pigtail catheter) [13]. For example, if an 8-F catheter is being inserted, then 7- and 9-F dilators are chosen. Following dilation, the catheter is advanced over the wire into the gallbladder. When the tip of the catheter enters the gallbladder, the catheter is unlocked from the inner stiffener and advanced over the wire into the gallbladder. The wire is then removed and the catheter is locked in position [13]. Bile is withdrawn for bacteriologic culture and the drain is connected to gravity drainage [1, 2]. The advantage of this technique is the use of a fine needle, which especially reduces the potential risk of an involuntary perforation of a neighbor organ. The main disadvantage of Seldinger technique is the multiplicity of maneuvers that make the procedure time-consuming. The “trocar” technique, (one-step technique, direct catheter over needle) allows direct insertion of the pigtail catheter. The trocar and the drain have the same diameter, which increases the risk of liver bleeding in transhepatic approach and also the inadvertent puncture of adjacent organs ensues [1, 2]. Although no important differences in complications have been reported when using either approach, the Seldinger technique is the preferred for using in practice.

PC using a central venous catheter (CVC) is proposed by some authors as a viable alternative to pigtail catheter [10], potentially useful in austere settings. From a practical point of view, a CVC is more propense to migrate due to the lack of internal fixation and also because of its shorter length; additionally, its small internal diameter does not allow to drain thick contents; therefore, the widespread use of CVC for gallbladder drainage cannot be recommended. A comparison between CVC and pigtail catheters is shown in Table 1.

Complications and technical failure

Several complications are possible during PC including vasovagal reactions, hemorrhages (some patients even require transfusions), pneumothorax for the transhepatic route and bile leak for the transperitoneal route [1, 2, 14], (Fig. 3) which can lead to biliary peritonitis, especially when bile is infected [2]. Drain migration is the more frequent complication [1], which is mainly reduced locking a pigtail drain and ensuring adequate fixation. More rarely, digestive tract perforations (duodenum, colon) can occur [1, 2].

Table 1 Comparison between locking pigtail catheters and central venous catheters for gallbladder drainage

	Pigtail catheter	Central venous catheter
Length	Up to 39 cm	Up to 20 cm
Outer diameter (French)	7–10 F (higher in some models, e.g., 16 F)	5 F
Internal fixation	Locking system	None
Sideholes	6 (up to 9 in some models)	None
Migration	Less-likely	Frequent
Drainage results	Usually successful	Limited by low flow and in especial with thick intraluminal gallbladder material

Fig. 3 Illustration depicting bile leakage related to a side hole on cholecystostomy tube that is misplaced outside of gallbladder lumen

Reasons for technical failure include a small gallbladder lumen, often as a result of multiple stones, preventing the accommodation of the catheter and a thickened gallbladder wall or a porcelain gallbladder, preventing needle insertion [1].

Contraindications

Contraindications to PC [2] are the interposition of gastrointestinal segments between the point of puncture and the gallbladder, coagulation disorders (relative contraindication, as mentioned previously) and biliary peritonitis, since in this case is required to clean the peritoneal cavity and resolve the underlying cause of peritonitis (gallbladder perforation).

Post-procedure care

Following the procedure, the drain should be maintained in place for at least 4 weeks, timeframe necessary for maturation of the tract. Certain conditions such as uncontrolled diabetes, long-term steroid therapy, malnutrition, the presence of ascites, or tract infection may delay tract maturation; in such cases, the drain should be left in place for a longer period of time [1, 2]. To prevent from clogging, the catheter is usually flushed with sterile saline twice a day. In some doubtful cases, when concerns exist regarding the permeability and position of the catheter, a guidewire can be passed through. This allows to unclog the catheter and it also serves as a guidance to exchange it for a larger size one.

Conclusion

US-PC should be considered as the principal therapeutic strategy in patients with AC who are unfit for general anesthesia and/or surgery, especially critical care patients or those with multiple comorbidities. Radiologists, surgeons, and also emergency physicians and intensivists (who actually widely use ultrasound in practice and also usually performs catheterization procedures), should be interiorized with the technique for performing the PC-US procedure since it is simple, has a low complication rate and a high likelihood of success, and may also be lifesaving.

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Conflict of interest Authors have no conflicts of interest related to this submission.

Ethical statement All human and animal studies have been approved by the appropriate ethics committee and have therefore been performed in accordance with the ethical standards laid down in Helsinki Declaration of 1975 and its late amendments.

Informed consent Written informed consent was obtained from the patient for the publication of this case report and accompanying images.

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