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INTERVENTIONAL RADIOLOGY

ORIGINAL ARTICLE

Efficacy and safety of ultrasound-guided bedside percutaneous cholecystostomy using the transhepatic approach and trocar technique in patients with acute cholecystitis

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PURPOSE

Despite the large number of patients requiring percutaneous cholecystostomy (PC) for acute cholecystitis (AC), no definitive results exist on the optimal imaging guidance modality, technique (Seldinger vs. trocar), or approach [transhepatic (TH) vs. transperitoneal]. This study evaluates the outcomes of ultrasound (US)-guided bedside PC using solely the TH approach and trocar technique in patients with AC.

METHODS

A single-center retrospective study was conducted at a tertiary university hospital between 2018 and September 2023. The study included 81 patients with AC treated with US-guided bedside PC using the TH approach and trocar technique alone. Patients were diagnosed through clinical, laboratory, and radiological examinations, and an experienced interventional radiologist performed the procedures. Outcomes and complication rates were then evaluated.

RESULTS

Technical and clinical success rates were 100% and 93%, respectively. No procedure-related complications occurred. Catheter dislodgement occurred in 4.9% (4/81). The catheter sizes used were 6 F (12.3%), 7 F (40.7%), 8 F (37%), and 10 F (9.9%). The median catheter dwell time was 42 days. Catheters were successfully removed in the majority of surviving patients following resolution of cholecystitis. At the end of the follow-up, 10 patients (12.3%) underwent elective cholecystectomy, and 12 patients (14.8%) died due to comorbidities with the catheter in place.

CONCLUSION

US-guided bedside PC using the TH approach and trocar technique is safe and effective for managing AC in high-risk patients. The study found no significant complications, highlighting the importance of thorough preprocedural evaluation and technique optimization. Further studies with larger, homogeneous patient groups are needed to compare outcomes across different PC techniques and approaches.

CLINICAL SIGNIFICANCE

Despite the growing adoption of PC in the management of AC, the definitive optimal access route and procedural technique remain unresolved. The current body of literature is limited by considerable heterogeneity across studies, including variability in technical approach, operator experience, patient coagulation profiles, and outcome definitions. This study exclusively employed bedside US-guided PC using the TH approach and trocar technique, and observed no procedure-related complications, including hemorrhage, bile leakage, infection, or abscess formation.

KEYWORDS

Acute cholecystitis, percutaneous cholecystostomy, transhepatic, trocar technique, ultrasonography

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Acute cholecystitis (AC) is one of the most common causes of emergency department admissions and carries high morbidity and mortality.[1,2] Although the standard treatment for AC is laparoscopic cholecystectomy, surgery carries a high-risk in patients with advanced age or with existing comorbidities. In the advanced age patient group, the surgical complication and mortality rates increase to 14%–30%.[3] Percutaneous cholecystostomy (PC) provides catheter-assisted gallbladder decompression under imaging guidance in high-risk patients. This approach can be used as a temporary or definitive treatment alternative to surgery in a bedside setting, is safe and rapid, and does not require general anesthesia.[3,4]

Ultrasonography, computed tomography (CT), fluoroscopy, or a combination of these modalities can provide the imaging guidance needed in PC procedures. Catheter insertion into the gallbladder lumen can be achieved using the trocar or Seldinger technique. The trocar technique involves directly placing a drainage catheter into the gallbladder cavity under imaging guidance. The Seldinger technique consists of initially accessing the gallbladder lumen with a thin needle and advancing a guidewire through the needle. The access route is dilated using consecutive dilators, and a larger PC drainage catheter is finally placed into the gallbladder lumen. The Seldinger technique is considered more reliable for initial access to the gallbladder because a fine needle is used. However, since this technique requires multiple dilations and over-the-wire exchanges, it is more time consuming than the one-step trocar technique.[5] The technique has also been deemed to carry a higher risk of bile leak and peritonitis.[6-9] The trocar technique, mainly when guided by ultrasound (US), is more operator dependent. It is a single-step, simpler, and quicker technique; however, it uses a larger diameter PC drainage catheter for the initial puncture of the gallbladder, which means it is believed to carry a greater risk.[5,8]

Main points

- The optimal access route for percutaneous cholecystostomy (PC) remains a subject of ongoing debate. This study contributes to the literature by providing outcome data from the exclusive use of the transhepatic (TH) approach and trocar technique in bedside ultrasound (US)-guided PC procedures.
- Bedside US-guided PC using the TH approach and the trocar technique alone is a safe procedure; the study found no procedure-related complications, including bleeding, bile leakage, infection, or abscess formation.
- The technical and clinical success rates of bedside US-guided PC using the TH approach and the trocar technique were 100% and 93%, respectively.
- A thorough preprocedural evaluation of the liver parenchyma and the hemostasis status of the patient, choosing the optimal TH route and the gallbladder puncture site, avoiding re-entries, and using small-caliber catheters may decrease the complication rates when performing US-guided PC using the TH approach and the trocar technique.
- Studies with large sample sizes involving homogeneous study groups regarding the operator experience level, PC technique and approach, patient coagulation status, and catheter sizes are needed to compare well-defined outcomes between different PC procedures.

The gallbladder lumen can be accessed using a transhepatic (TH) or transperitoneal approach (TP).[10] Of the two methods, the TH approach is considered to have a lower likelihood of bile leakage, a lower risk of catheter dislodgement, and a quicker maturation of the drainage route. Traversing the liver parenchyma in the TH approach has been reported to be associated with a higher risk of bleeding, especially when an underlying hepatic pathology is present.[6-9] However, no consensus exists on the optimal PC route. A recent meta-analysis of retrospective studies comparing TH and TP routes in PC in terms of complications concluded that there were confounding factors between these studies, such as the use of both Seldinger and trocar techniques, the variations in the catheter sizes, and the variations in definitions of outcomes and of complications.[6]

Despite the increasing use of PC as a temporary or definitive treatment method for AC, there is a paucity of literature on the optimal approach and technique.[5,6] The choice of PC access route has traditionally depended on operator preference and anatomical considerations; two recent Delphi consensus studies have addressed this issue. The 2024 international Delphi study led by Ramia et al.[11] recommended the TH route as the preferred approach. However, the 2025 Delphi consensus by Pesce et al.[12] accepted both TH and TP routes as viable, emphasizing the role of center-specific expertise and patient anatomy in decision-making. Despite these efforts, no definitive agreement has been reached, and access route selection remains controversial, as highlighted in a recent commentary calling for stronger leadership from interventional radiologists in resolving this debate.[13] Considering the ongoing debate surrounding the optimal access route for PC, this study aimed to contribute to the literature by evaluating the outcomes of US-guided bedside PC performed exclusively using the TH approach and the trocar technique in patients with AC, focusing on technical success, clinical efficacy, complication rates, and clinical and laboratory findings.

Methods

This single-center retrospective study was conducted at Eskişehir Osmangazi University Hospital, a tertiary care university hospital, between 2018 and September 2023. The Eskişehir Osmangazi University Ethics Committee approved the study on June 20, 2023, with decision no.: 24. Written informed consent was obtained from all patients included in the study.

The study included patients with AC treated with US-guided bedside PC using the trocar technique and the TH approach. All patients included were consecutive cases meeting the inclusion criteria during the study period. All patients presented to the emergency department with signs and symptoms of AC. The diagnosis was made through clinical, laboratory, and radiological examinations. Each patient had American Society of Anesthesiology (ASA) scores of 3 or 4, and the consultant general surgeon decided the indication for PC. Patients undergoing PC procedures performed for reasons other than AC (performed during transarterial chemoembolization or ablation procedures) were excluded from the study, as were individuals aged under 18 and pregnant women.

Preprocedural diagnostic abdominal US and CT were performed on all patients included in the study. Volumetric measurements of the gallbladder were obtained through CT and US. For the definition of gallbladder hydrops, a criterion of a transverse diameter greater than 4 cm and a longitudinal diameter greater than 9 cm was used.[14] The presence or absence of gallbladder stones was noted. Procalcitonin, leukocyte, alanine transaminase (ALT), aspartate aminotransferase (AST), alkaline phosphatase (ALP), and gamma-glutamyl transferase (GGT) values were recorded. Anticoagulant and antiplatelet use was determined in all patients before the procedure. A hemostasis panel was obtained, which included activated partial thromboplastin time (aPTT), international normalized ratio (INR), and platelet count. Care was taken to ensure the platelet count was over 50,000, the INR value was below 1.5,

and the aPTT value was within normal limits. Anticoagulant and antiplatelet drugs were discontinued at appropriate intervals according to the Society of Interventional Radiology (SIR) guidelines if suitable.[15,16] In patients with unsuitable hemostasis panels, abnormal coagulation parameters were corrected with fresh frozen plasma and thrombocyte suspension infusion.

Procedures

A single interventional radiologist with 25 years of experience in interventional radiology performed all the procedures, which were conducted at the bedside with US guidance. All PC procedures at our institution are routinely performed using the trocar technique via the TH route, regardless of anatomical variation or complexity. The TH route and trocar technique were deliberately selected based on the interventional radiologist's experience and preference at our institution. To date, the Seldinger technique and the TP approach have not been utilized as part of institutional practice in conjunction with US-guided bedside interventions. Accordingly, all cases included in this study represent the total population of PC procedures performed at our center during the study period. No cases were excluded based on access route or technique.

The patient was placed in a supine or semi-decubitus position. After applying 10 mL of prilocaine to the skin and the liver capsule, access to the gallbladder was achieved transhepatically using an intercostal approach. This approach was specifically chosen to access the gallbladder because all patients in the study were monitored in the intensive care unit (ICU) and used abdominal muscle support during breathing, which may increase the risk of catheter dislodgement. Additionally, this approach is considered by the operator to provide a more appropriate intraparenchymal course, thereby improving catheter stability and decreasing the risk of dislodgement.

A convex US probe (Samsung HS 50™, Samsung Medison Co., ,Seoul, South Korea) was used for imaging guidance, and an out-of-plane freehand technique was used for the access. A 6–10-F trocar-locked pigtail catheter (SKATER™, Argon Medical Devices™, Frisco, TX, USA) was placed into the gallbladder lumen. Catheter caliber was selected at the discretion of the interventional radiologist, considering gallbladder distension, the composition of biliary contents, and catheter availability at the time of the procedure. A 10-F catheter was specifically reserved for cases with an anticipated risk of clogging due to the presence of thick, viscous, or tumefactive content-sludge.

Following confirmation of the pigtail shape of the catheter within the lumen with US guidance, the catheter was locked (Figure 1). A 5-mL lumen sample was obtained for bacterial culture, and the catheter was secured to the skin. Spontaneous catheter drainage was allowed following active aspiration of the lumen contents.

No sedation other than local anesthesia (prilocaine, CİTANEST®, AstraZeneca PLC, İstanbul, Türkiye) was administered during the procedures. Intravenous analgesics were administered for post-procedural pain management in all patients, who were monitored in the ICU throughout the post-intervention period.

Follow-up

All patients were followed up for bleeding by monitoring hemoglobin levels. Procalcitonin, leukocyte, ALT, AST, ALP, and GGT values were obtained at least weekly in all patients following the procedure. The catheter was removed in all patients after 4–6 weeks to allow the inflammation to subside and for the catheter tract to mature. This waiting period was necessary for the safe withdrawal of the catheter.[6] The exceptions were patients who underwent cholecystectomy, in whom the catheter was removed intraoperatively, and those who died before catheter removal. Abdominal US was performed in all patients before the removal of the catheter. The catheter removal was only performed if the imaging findings of AC were no longer present, the catheter flow was less than 10 mL per 24 hours, and the patient's clinical and laboratory inflammation findings had subsided. Decisions to remove the catheter were based solely on clinical and imaging criteria, and a clamping test or fistulography was not performed before removing the catheter.

Definitions of outcomes

Technical success was defined as ultrasonography verification of correct PC catheter placement within the gallbladder lumen with subsequent bile aspiration.[17] Clinical success was defined as the gradual subsidence of signs, symptoms, and inflammatory markers during the first 72-hour post-procedural follow-up.[17] Based on the SIR classification, the complications were categorized as minor or major.[18] Tube dislodgement was defined as the dislodgement of the pigtail catheter from the gallbladder lumen, whether or not remaining in the patient. Catheter removal caused by the patient pulling it out was not included in the definition of catheter dislodgement.[6] Bleeding was defined as fluid or hematoma in the extracapsular, subcapsular, or subcutaneous area at the level of the insertion or in the gallbladder bed in immediate post-procedural ultrasonography. Bile leakage was defined as fluid around the catheter, gallbladder, or liver on immediate or any follow-up post-procedural ultrasonography. A wound infection was defined as a skin infection of the PC insertion site, and an abscess was defined as a localized skin infection requiring incision and drainage. Mild skin erythema at the PC insertion site was not defined as a skin infection.[6]

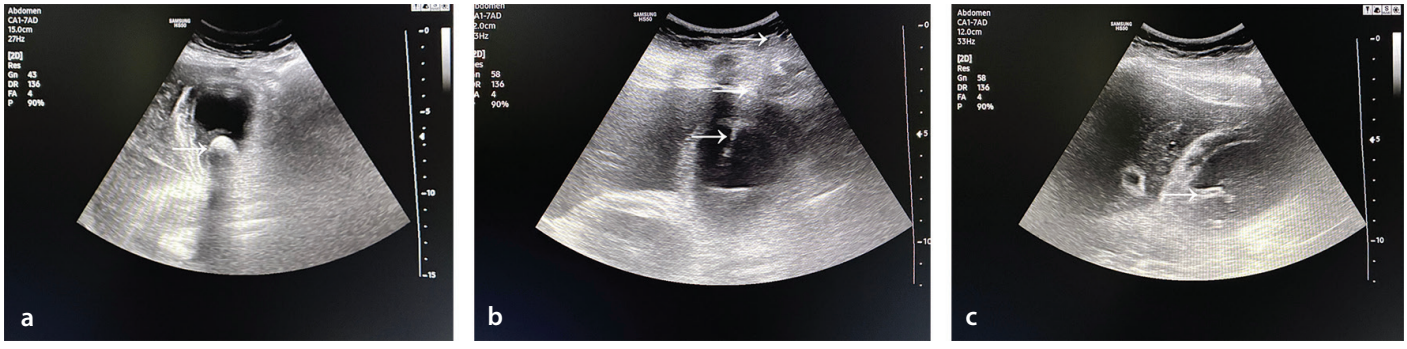

Figure 1. Representative grayscale ultrasonographic images showing the transhepatic route of the catheter during trocar technique-based percutaneous cholecystostomy. **(a)** Hyperechoic focus with posterior acoustic shadowing is visible within the gallbladder lumen, consistent with a gallstone (white arrow). **(b)** The echogenic catheter (white arrows) is seen traversing the liver parenchyma toward the gallbladder, confirming the transhepatic access. **(c)** The pig-tail catheter tip (arrow) is visualized within the gallbladder lumen, indicating successful placement.

Statistical analysis

The data was analyzed using IBM SPSS for Windows 11 (IBM, Armonk, NY, USA). The Shapiro–Wilk test was used to determine the variables' suitability for normal distribution. In summarizing the data, number and percentage statistics were used for qualitative data and the median for quantitative data.

Results

The study included 81 patients (40 women and 41 men) treated with US-guided PC using the TH approach and trocar technique alone (mean age: 75.3). Table 1 summarizes the demographic characteristics, preprocedural laboratory findings, catheter specifications, microbiological culture results, clinical outcomes, and complication rates of the study population.

The technical and clinical success rates for the PC procedures in the study were 100% and 93%, respectively. No procedure-related complications—including bleeding, bile leak, skin infection, or abscess formation—occurred during the immediate post-procedural period or the patients' follow-up. In 4 patients (4.9%), dislodgement of the cholecystostomy catheter was observed. The 30-day and 90-day mortality rates in the study population were 9.8% (8/81) and 14.8% (12/81), respectively.

Fifty-five patients had calculous AC, whereas 26 had acalculous AC. Notably, all of our patients were hospitalized in the ICU at the time of PC, a condition known to increase the risk of developing acalculous AC.

Seventy-four patients had a hydropic gallbladder at the time of admission. The median gallbladder volume was 165 mL. The microbiological culture results for the gallbladder aspiration material were available for 60 of 81 patients. The results showed *Escherichia coli* in 20 of 60 patients and bacteria other than *E. coli* in 26. In 16 of 60 patients, cultures of the aspiration material did not show any microbiological agent.

A 6-F catheter was used in 10 patients, a 7-F catheter in 33 patients, an 8-F catheter in 30 patients, and a 10-F catheter in 8 patients. In patients discharged and followed up in outpatient clinics, the median duration of the catheter stay was 42 days.

The median time between the emergency department admission and the PC procedure was 2 days (min: 1 day; max: 34 days). In 10 patients, the PC procedure was used as a bridge treatment before cholecystectomy. The average time between PC and cholecystectomy was 30.5 days (min: 1 day; max: 52 days).

Twelve patients (14.8%) died during the ward follow-up period. The median post-procedural survival of the patient group who died during this period was 13.5 days. Sixty-nine patients (79.2%) were discharged after a ward stay period and were followed up in outpatient clinics.

Table 1. Patient demographics and laboratory findings

Age	77 (19–94)
Sex	
Male (%)	41 (50.6%)
Female (%)	40 (49.6%)
Median catheter dwell time	42 (1–86)
Mean gallbladder volume (mL)	130 (37–625)
Preprocedural laboratory (mean)	
CRP value (mg/L)	150.5 (0.5–512)
Procalcitonin value (ng/mL)	1.885 (0.04–60.53)
Leucocyte count (10^3/uL)	12.900 (4.200–32.600)
ALT value (U/L)	20.5 (3–3.250)
AST value (U/L)	34 (7–9.560)
ALP value (U/L)	111.5 (51–1.379)
GGT value (U/L)	62 (8–1.799)
Median days of treatment before PC	1 (1–34)
American Society of Anesthesiology grade (median)	3
Catheter diameter frequencies	
6 F	10 (12.3%)
7 F	33 (40.7%)
8 F	30 (37%)
10 F	8 (9.9%)
Microbiological culture results	
Microbiological culture data not available	21 (26%)
Sterile microbiological culture	17 (21%)
Escherichia coli	15 (19%)
Bacterial growth other than *E. coli*	28 (35%)
Cholecystitis	
Calculus	55 (67%)
Acalculous	26 (32%)
Perforation	4 (5%)
Ascites	0 (0%)
Clinical success	
Yes	76 (94%)
No	5 (6%)
Complications	
Total	4 (4.9%)
Catheter dislodgement	4 (4.9%)

ALT, alanine aminotransferase; AST, aspartate aminotransferase; ALP, alkaline phosphatase; CRP, C-reactive protein; GGT, gamma-glutamyl transferase; PC, percutaneous cholecystostomy.

Discussion

PC for calculous or acalculous AC has proven effective and safe in patients with old age or multiple and significant comorbidities.[5,6,8] The procedure's technical and clinical success rates range between 98.9% and 100%, and 85.6% and 97.5%, respectively,[17,19-22] and its complications are minor, with low occurrence rates.[5,6] Despite the large number of patients requiring PC for AC and the increasing use of PC in these patients, no definitive results exist regarding the optimal imaging guidance modality (US, CT, or fluoroscopy), technique (Seldinger vs. trocar), or approach (TH vs. TP).

In the PC procedures in the present study, ultrasonography was preferred as the sole imaging guidance modality because it allows for the procedure to be performed entirely at the bedside and provides urgent and quicker treatment without patient transportation and mobilization issues.

Although both the trocar and the Seldinger techniques are widely used for PC, recent prospective randomized trials have demonstrated that the former is at least non-inferior, and in some outcomes possibly superior, to the latter technique in terms of complication rates, procedure time, and bile leakage risk.[5,6,23] In the present study, the trocar technique was deliberately selected due to its compatibility with US-only guidance, which allows for bedside application without the need for patient transport or fluoroscopy. Additionally, in the setting of AC, where inflammation and wall necrosis increase vulnerability to injury, avoiding multiple tract dilations—as required in the Seldinger method—may offer a technical advantage. Therefore, this study aimed to further evaluate the safety and efficacy of the US-guided bedside trocar technique combined with the TH approach, without comparison to the Seldinger method.

Despite the larger diameter of the initial puncture in the trocar technique, we did not observe any minor or major bleeding complications in any PC procedures. This was in accordance with one prospective study comparing the complication rates between US-guided trocar and US-guided Seldinger PC techniques.[5] The study found the minor bleeding (bile mixed with blood) rate to be as low as 2% (1 out of 50 patients) in each technique, and there was no statistically significant difference in the occurrence of minor bleeding events between the two techniques.[5] The size of the drainage catheter used may be a factor affecting the bleeding complication rates in PC.[24] Using a small-caliber 6-F or 7-F catheter in more than half of the patients in the present study (6 F in 10 patients and 7 F in 33 patients) may have contributed to the lack of bleeding complications. However, the approach (TH vs. TP) used in PC procedures and the operator experience may also affect the bleeding complication rates.[5,6] In PC procedures performed via the TH route, choosing the optimal tract—such that the tract is short enough to avoid bleeding and long enough to allow for tract maturation—may depend on the operator's experience.

Several retrospective observational studies have reported the effect of the approach (TH vs. TP) on the complication rates in PC procedures.[7,25,26] A recent meta-analysis found that although the overall rate of bleeding complications was higher in the TH approach, the studies included in the analysis had significant differences in the technique used (trocar vs. Seldinger), the catheter size used, the number of patients, the number and the experience of the operators, and the definition of the bleeding (e.g., bleeding as visible hemorrhage at the tube site occurring following discharge, bleeding requiring immediate intervention, bleeding as gallbladder hemorrhage occurring in the immediate periprocedural period).[6] A recent multicenter retrospective study, the MACAFI study, comparing the results of the TH and TP approaches in PC in a total of 913 patients, found a significantly greater rate of intraprocedural bleeding in the TH approach than in the TP approach (2.6% vs. 0.3%).[8] However, the MACAFI study also had a heterogeneous study population regarding the technique used; most cases were performed using the Seldinger technique due to safety preferences. The study did not find a significant association between tube size and intraprocedural bleeding rates; however, most cases in both TH and TP groups were performed using an 8 F or larger catheter, with the catheter size ranging between 6 and 12 F. Moreover, no records were available on the risk factors for bleeding (e.g., underlying liver disease, abnormal hemostasis panel, anticoagulant use, decision or not to correct periprocedural coagulopathy). The periprocedural coagulation status of the patients, the presence of any underlying liver disease, and the number of re-entries may significantly affect the bleeding outcome when performing PC via the TH approach. Therefore, the present study's lack of bleeding complications may be related to the fact that there were no patients with underlying liver disease, abnormal coagulation parameters were corrected pre-procedurally in all patients, and no re-entries were performed during the procedures.

Regarding the risk of bile leakage, the TH approach has been associated with less risk than the TP approach, mainly due to the tampon effect exerted by the liver parenchyma.[25] However, the retrospective studies comparing the bile leakage rates between the TH and TP approaches were not homogeneous in the technique used. In Beland et al.'s[7] study, the trocar technique was used in 69.5% and 34.9% of the cases performed via the TP and TH approaches, respectively. In Bennett et al.'s[9] study, 79 of the 165 cases were performed using the trocar technique; however, no information was given on how many of the cases were managed with the trocar technique in conjunction with the TH approach. The MACAFI study reported using the Seldinger technique in "most" cases.[8] Although confounded by using two different techniques and different operators with varying levels of experience, previous retrospective studies found no statistically significant difference in bile leakage rates between the TH and TP approaches.[6,8]

Two prospective studies compared the bile leakage rates between the trocar and the Seldinger techniques in PC. Reppas et al.[23] found a higher rate of bile leakage in US- and fluoroscopy-guided PC procedures performed with the use of the Seldinger technique than in US-guided PC procedures performed with the use of the trocar technique (bile leakage occurred in 4 of 52 cases performed using the Seldinger technique vs. 0 of 53 cases performed using the trocar technique). Arkoudis et al.[5] reported one biloma in 50 patients who underwent US-guided PC using the Seldinger technique. In contrast, no cases of bile leakage were observed in the 50 patients who underwent US-guided PC using the trocar technique.[5] The authors of the two studies concluded that the US-guided trocar technique in PC is as safe as the Seldinger technique, if not safer.[24] It is worth noting that in PC procedures performed via the TH approach using the trocar technique, the gallbladder puncture site can also affect the risk of bile leakage. To use the tamponage effect of the liver parenchyma, puncturing the gallbladder wall at its corpus rather than at its fundus or infundibulum may reduce the risk of bile leakage.

The TH approach in PC has been considered less prone to catheter dislodgement than the TP approach due to the liver's sup-

port and traction effect.[8] Few studies evaluating the outcome of catheter dislodgement varied in their definitions of "dislodgement," and some included pulled-out catheters in the category of dislodgement. Excluding the pulled-out catheters, a meta-analysis of four studies on the incidence of catheter dislodgement in PC procedures found no statistically significant difference in catheter dislodgement rates between the TH and the TP approaches. Dislodgement was reported in a total of 15 of 361 cases performed using the TH approach (4.1%) compared with a total of 17 of 311 cases performed via the TP approach (5.4%).[6] The catheter dislodgement rate in the present study was 4.9%.

The present study found the 30-day and 90-day mortality rates following PC to be 9.8% and 14.8%, respectively. The MACAFI study also reported similar outcomes, with a 30-day mortality rate of 8.7% and a 90-day mortality rate of 13.8% for the TH group.[8] It is important to note that the mortality rate observed should not be directly attributed to PC but rather to the patient's pre-existing health conditions, morbid conditions, advanced age, and the presence of associated sepsis. Additionally, the presence of a PC catheter during the patients' ward follow-ups or at the time of death should not be considered a complication of PC or indicative of treatment failure. These patients, classified as ASA 3 and 4, are not typically planned for surgery, and the PC catheter is present as a definitive treatment at the time of death.[5]

Gandhi et al.[27] conducted a retrospective study involving ICU patients who underwent bedside PC under US guidance. In their cohort, all procedures were performed via the TH route using the Seldinger technique, in contrast to our study, where the trocar technique was employed. Smaller-caliber pigtail catheters (7–8 F) were utilized, and tract dilatation due to the catheter size was omitted. The authors reported a technical success rate of 100% and a clinical success rate of 92.1%, closely aligning with our outcomes. However, 1 patient (1.9%) developed a bile leak, likely due to multiple puncture attempts, and required surgical intervention. Importantly, no major complications were observed. The mean catheter dwell time in Gandhi et al.'s[27] study was 13 days (range: 3–45), which was shorter than in our series. A clamping trial was performed in 3 patients before elective tube removal. These findings underscore notable procedural differences—particularly the choice of access method and catheter management strategies—which may influence complication profiles and clinical outcomes. Comparative studies are warranted to evaluate further the impact of trocar versus Seldinger techniques in critically ill patients requiring bedside PC.[27]

Based on previous experience, the operator in the present study did not perform a clamping test or fistulography before catheter removal, and no recurrent AC cases were detected in any patients. However, the authors of this study consider the clamping test and fistulography to be safer and more objective procedures compared with clinical and imaging findings, and they suggest using them to confirm bile flow before catheter removal.

The main limitations of the present study are its retrospective nature and single-center design with a limited number of patients. All PC procedures at our center are performed using the same approach and technique; thus, a comparative outcome analysis of different approaches or techniques could not be presented. Most of the patients involved in the study had impaired consciousness due to their systemic severe illnesses. Consequently, obtaining valid and objective visual analog scores for pain assessment was impossible, meaning no pain-related data were collected.

In this study, the technical and clinical success rates of US-guided PC were 100% and 93%, respectively, which are at the higher end of the ranges reported in the literature. Differences in clinical success rates across studies may result from how clinical success is defined (e.g., subsidence of imaging and/or laboratory parameters), the timing of the assessments, the interval from patient admission to PC procedure, and the antibiotic regimens used. Additionally, comorbidities and the overall condition of the patients included in the study can influence clinical success rates. However, this study was not designed to assess the factors that could impact clinical success.

In conclusion, despite the increasing use of PC for the treatment of AC, current literature data on the optimal PC technique and the approach are indefinite; most retrospective studies on the subject are heterogeneous in terms of technique and approach, the number and experience level of the operator(s), and the coagulation status of the patients, and have variations in their definitions of outcomes. Therefore, the choice of the PC technique and the approach remains at the operator's discretion on a case-by-case basis.[5,6] The present study on 81 consecutive patients with AC treated by a single operator with bedside US-guided PC using the TH approach and the trocar technique alone found no procedure-related complications, including bleeding, bile leakage, infection, or abscess formation. A thorough preprocedural evaluation of the liver parenchyma and the hemostasis status of the patient, choosing the optimal TH route and the gallbladder puncture site, avoiding re-entries, and using small-caliber catheters may decrease the complication rates when performing US-guided PC using the TH approach and the trocar technique. Further studies with large sample sizes involving homogeneous study groups regarding operator experience level, PC technique and approach, patient coagulation status, and catheter sizes are needed to compare well-defined outcomes between different PC procedures.

Footnotes

Conflict of interest disclosure

The authors declared no conflicts of interest.

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