

Clinical Outcomes and Safety of Ureteral Catheter-Assisted Antegrade Guidewire Intubation in the Laparoscopic-Endoscopic Rendezvous Procedure for Cholelithiasis with Choledocholithiasis: A Retrospective Cohort Study

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Background and Purpose: The laparoscopic-endoscopic rendezvous procedure, which integrates laparoscopic cholecystectomy with intraoperative endoscopic retrograde cholangiopancreatography (ERCP), is an established therapeutic strategy for patients with cholelithiasis and concomitant choledocholithiasis. This study evaluated the impact of ureteral catheter-assisted antegrade guidewire intubation on the procedural success rate and duration of the rendezvous technique, with additional assessment of safety and clinical efficacy.

Methods: Clinical data were retrospectively analyzed from patients with cholelithiasis and concomitant choledocholithiasis who underwent laparoscopic cholecystectomy at the South Campus of Taizhou Hospital (Enze Hospital), Zhejiang Province, between May 2019 and December 2022. A total of 116 patients were assigned to either a control group or an intervention group in which ureteral catheter-assisted guidewire insertion was employed.

Results: The success rate of antegrade guidewire intubation was 98.3% in the intervention group, compared to 91.2% in the control group. The intervention group demonstrated a statistically significant reduction in guidewire insertion time ($p < 0.05$). No statistically significant differences were observed between groups in terms of intraoperative hospitalization costs, total hospitalization duration, postoperative serum amylase levels or postoperative hospitalization duration ($p > 0.05$). The total operative duration tended to be lower but did not reach statistical significance in the intervention group compared to the control group, with a p-value of 0.054. No cases of postoperative bile leakage were reported. In the control group, the incidence of acute pancreatitis was 2%, and the incidence of hyperamylasemia was 28.8%. In the intervention group, hyperamylasemia occurred in 25.9% of cases, with no reported instances of acute pancreatitis. Additionally, one patient in the control group developed a pulmonary embolism, and two patients developed ascites accompanied by fever.

Conclusion: The use of ureteral catheter-assisted antegrade guidewire intubation during the laparoscopic-endoscopic rendezvous procedure appears to be a safe and clinically effective approach for managing cholelithiasis and concomitant choledocholithiasis. This technique is associated with a high success rate of guidewire realignment, reduced procedural duration, and a lower incidence of procedure-related complications.

Keywords: common bile duct stones, gallbladder stones, rendezvous technology, ureteral catheter, zebra guidewire antegrade intubation



Introduction

Cholelithiasis with concomitant choledocholithiasis is a frequently encountered condition in hepatobiliary surgery. Its incidence has increased in recent years, partly due to improved life expectancy and lifestyle change. In some patients, duodenal papillary stenosis may also be present.¹ Current clinical management of cholelithiasis with concomitant choledocholithiasis is characterized by a multimodal approach, with minimally invasive techniques forming the core strategy. These primarily include laparoscopic cholecystectomy (LC) combined with either preoperative or postoperative endoscopic retrograde cholangiopancreatography (ERCP) for stone extraction, laparoscopic common bile duct exploration (LCBDE) with T-tube drainage, and the laparoscopic-endoscopic “rendezvous” technique. For complex cases involving large or numerous stones, biliary strictures, or anatomical anomalies, open common bile duct exploration remains the definitive surgical option. Previous studies have demonstrated that the laparoscopic-endoscopic “rendezvous” technique is an effective strategy for the management of cholelithiasis and choledocholithiasis.^{2,3} This approach involves a standard laparoscopic cholecystectomy, during which a zebra guidewire is advanced through the cystic duct and duodenal papilla, followed by ERCP for stone extraction. Reported bile duct clearance rates range from 90% to 94%, with low complication rates and a reduced risk of post-ERCP acute pancreatitis.⁴

Antegrade guidewire intubation offers technical advantages by facilitating more rapid and straightforward access to the common bile duct (CBD) while reducing the risk of duodenal papillary edema and pancreatitis. In clinical practice, laparoscopic cholecystectomy is typically performed from a caudal angle. However, advancing the zebra guidewire through the cystic duct using contrast forceps presents challenges, as the guidewire often deviates toward the upper portion of the CBD. Additionally, the soft, hydrophilic tip of the guidewire impairs handling with laparoscopic instruments, complicating directional control during antegrade insertion difficult. The extended length of the guidewire within the CBD further reduces maneuverability, potentially prolonging operative time and increasing the risk of intubation failure. The laparoscopic-endoscopic rendezvous technique itself is well-established, and ureteral catheters are routinely utilized in urological procedures for guidewire guidance. However, the adaptation and systematic application of a ureteral catheter specifically to facilitate antegrade guidewire intubation during the rendezvous procedure for cholecystocholedocholithiasis represents a novel technical modification. This approach aims to address the specific challenges of guidewire handling and direction control encountered with traditional forceps.

The present study introduced a simplified technique for antegrade zebra guidewire intubation and evaluated its feasibility and safety in patients with cholelithiasis and concomitant choledocholithiasis undergoing the laparoscopic-endoscopic rendezvous approach. This cohort study has been reported inline with the STROCSS guidelines.

Patients and Methods

A retrospective analysis was conducted on 116 consecutive patients diagnosed with choledocholithiasis with concomitant cholelithiasis between May 2019 and December 2022. Ethical approval for the study was obtained from the Ethics Committee of Taizhou Hospital of Zhejiang Province, Wenzhou Medical University. Diagnosis was established based on clinical presentation, serological findings, hepatobiliary ultrasonography, abdominal computed tomography (CT), and/or magnetic resonance cholangiopancreatography (MRCP).

Exclusion criteria were: (1) intrahepatic bile duct stones; (2) severe inflammatory conditions, including severe acute cholecystitis, acute pancreatitis, and acute obstructive suppurative cholangitis; (3) history of previous upper abdominal surgery or prior ERCP; and (4) biliary tumors.

Of the 116 patients initially assessed (Figure 1), 6 cases (5 in the control group and 1 in the intervention group) were excluded due to unsuccessful antegrade guidewire intubation via the cystic duct. Ultimately, 110 patients met the eligibility criteria and were included in the analysis. The control group comprised of 52 patients who underwent angiographic forceps-assisted antegrade guidewire intubation via the cystic duct. The intervention group included 58 patients who underwent ureteral catheter-assisted antegrade guidewire intubation via the cystic duct.

Among the 110 patients (56 men and 54 women; mean age = 53.3 years, range = 20–82 years), several presented with one or more risk factors for post-ERCP pancreatitis, including age < 60 years (66 patients), female sex (54 patients), and CBD diameter < 8 mm (60 patients).^{5–7}

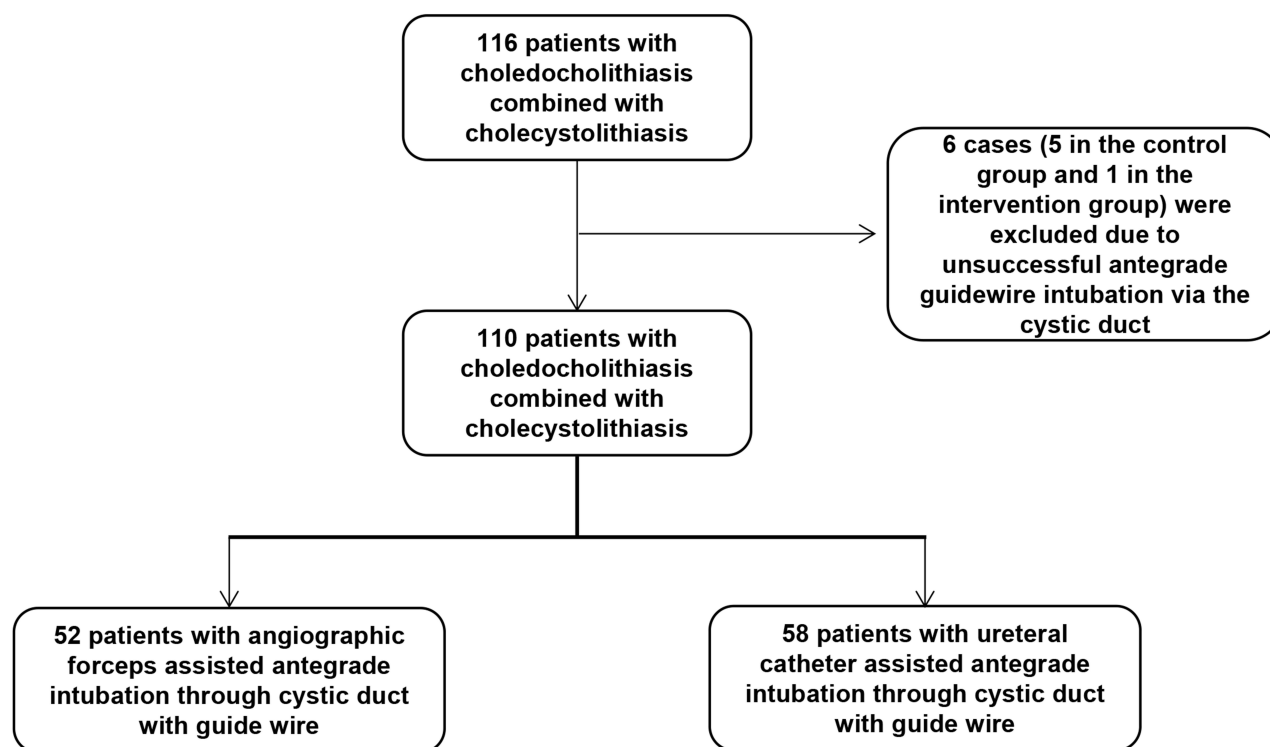


Figure 1 Patient enrollment.

All procedures were performed by experienced biliary surgeons at the study center. Data collected included demographic characteristics, presenting symptoms, preoperative serological results, number and size of stones identified intraoperatively, diameter of the CBD, surgical costs, total hospital stay, postoperative hospital stay, operative duration, and duration of antegrade guidewire intubation via the cystic duct.

Intubation time was defined as the interval between preparation of the intubation device and radiographic confirmation of guidewire entry into the duodenum. The primary outcome was the incidence of bile leakage, defined as the presence of bile in the abdominal drainage or ascitic fluid confirmed by puncture, or clinical signs of localized or generalized peritonitis. CBD and cystic duct diameters were measured by MRCP and intraoperative catheterization.

Antegrade guidewire intubation was considered unsuccessful if the procedure exceeded 20 minutes. Postoperative follow-up was conducted at 1 month in the outpatient clinic and subsequently every 6 months thereafter via telephone.

Surgical Strategy

Following induction of general anesthesia with endotracheal intubation, patients were positioned supine. Laparoscopic cholecystectomy was performed using a standard three-trocar technique with carbon dioxide pneumoperitoneum maintained at 13 mmHg. A 10 mm trocar was inserted at the umbilicus, and two 5 mm trocars were inserted at the midclavicular line and below the xiphoid process.

Dissection of Calot's triangle was performed to identify and isolate the cystic artery, which was then clipped and divided. Cholecystectomy was carried out in a standard antegrade manner. After complete mobilization of the gallbladder from the liver bed, the distal end of the cystic duct was clipped, and the proximal end was incised to allow antegrade guidewire intubation. The cystic duct was preserved without transection to facilitate guidewire passage. Upon fluoroscopic confirmation of guidewire positioning within the duodenum, the pneumoperitoneum was released.

Control Group: Angiographic Forceps-Assisted Technique

In the control group (Group A), a yellow zebra guidewire was introduced into the abdominal cavity using angiographic forceps. The gallbladder was elevated to align the axis of the cystic duct. The guidewire was inserted through a lateral incision in the cystic duct, and advanced through the duodenal papilla (Figure 2).

Intervention Group: Ureteral Catheter-Assisted Technique

In the intervention group (Group B), the tip of a 5 Fr ureteral catheter was trimmed. The guidewire was introduced into the catheter such that approximately 1 cm of the hydrophilic end extended beyond the catheter tip. The distal end of the catheter was secured with a vascular clamp to prevent displacement. The assembled device was inserted into the abdominal cavity via the midclavicular trocar, and antegrade guidewire intubation was performed through the cystic duct (Figure 3).

Subsequently, ERCP was performed with a duodenoscope operated by an endoscopist and an assistant. After the duodenoscope reached the descending portion of the duodenum, the guidewire was retrieved through the working channel using a stone retrieval basket. A papillotome was then advanced over the guidewire to perform cholangiography and confirm the presence of CBD stones. Endoscopic sphincterotomy or balloon dilation was performed based on cholangiographic findings and the condition of the duodenal papilla.

Stones were extracted using a retrieval basket, and repeat cholangiography was conducted to confirm complete clearance of the CBD. Balloon catheter sweeping was performed when necessary. A nasobiliary catheter was placed in the CBD if indicated. Residual intestinal gas was aspirated via the duodenoscope, and pneumoperitoneum was re-established.

Abdominal lavage was performed, and the proximal cystic duct was secured with two ligation clips. A drainage tube was positioned, and the procedure was completed. Serum amylase levels were measured at 3 hours and 24 hours postoperatively.

Statistical Analysis

All statistical analyses were performed using IBM SPSS Statistics, version 22.0 (IBM Corp., Chicago, IL, USA). Continuous variables are presented as mean $\pm$ standard deviation (SD). Comparisons of continuous variables were performed using the Student's *t* test, whereas categorical variables were analyzed with the Cochran–Mantel–Haenszel chi-squared (χ^2) test or Fisher's exact test, as appropriate. All tests were two-tailed, and a *p* value < 0.05 was considered statistically significant.

Results

In the control group, antegrade guidewire intubation via the cystic duct was unsuccessful in 5 patients, resulting in a success rate of 91.2% (52/57). These cases were subsequently intubated successfully using the ureteral catheter-assisted technique. In the intervention group, 1 patient experienced initial failure but was successfully intubated with conventional ERCP, resulting in a success rate of 98.3% (58/59). Six patients were excluded from the statistical analysis.

No cases of acute pancreatitis were observed in the intervention group. In contrast, 1 patient in the control group developed mild postoperative acute pancreatitis ($p = 0.473$), which resolved with conservative treatment. Additionally, 1 patient in the control group had inadvertent insertion of the stone retrieval basket into the pancreatic duct, resulting in a transient elevation of serum amylase levels without clinical features of pancreatitis.

The mean duration of antegrade guidewire intubation via the cystic duct was 11.94 ± 5.40 minutes in the control group and 8.41 ± 3.62 minutes in the intervention group ($p < 0.001$). The mean operative duration was 170.50 ± 46.89 minutes in the control group compared with 154.55 ± 39.09 minutes in the intervention group ($p = 0.054$). The mean hospitalization costs were RMB $23699.21 \pm 4,313.73$ in the control group and RMB $23,184.60 \pm 3,790.18$ in the intervention group ($p = 0.507$). The mean hospital stay was 8.04 ± 3.19 days in the control group and 7.45 ± 2.60 days in the intervention group ($p = 0.288$).

In the control group, 1 patient developed a pulmonary embolism and 2 patients developed ascites with fever; all were managed successfully with symptomatic treatment. No procedure-related complications, including abdominal infection, pulmonary embolism, duodenal papillary hemorrhage, or gastrointestinal perforation, occurred in the intervention group.

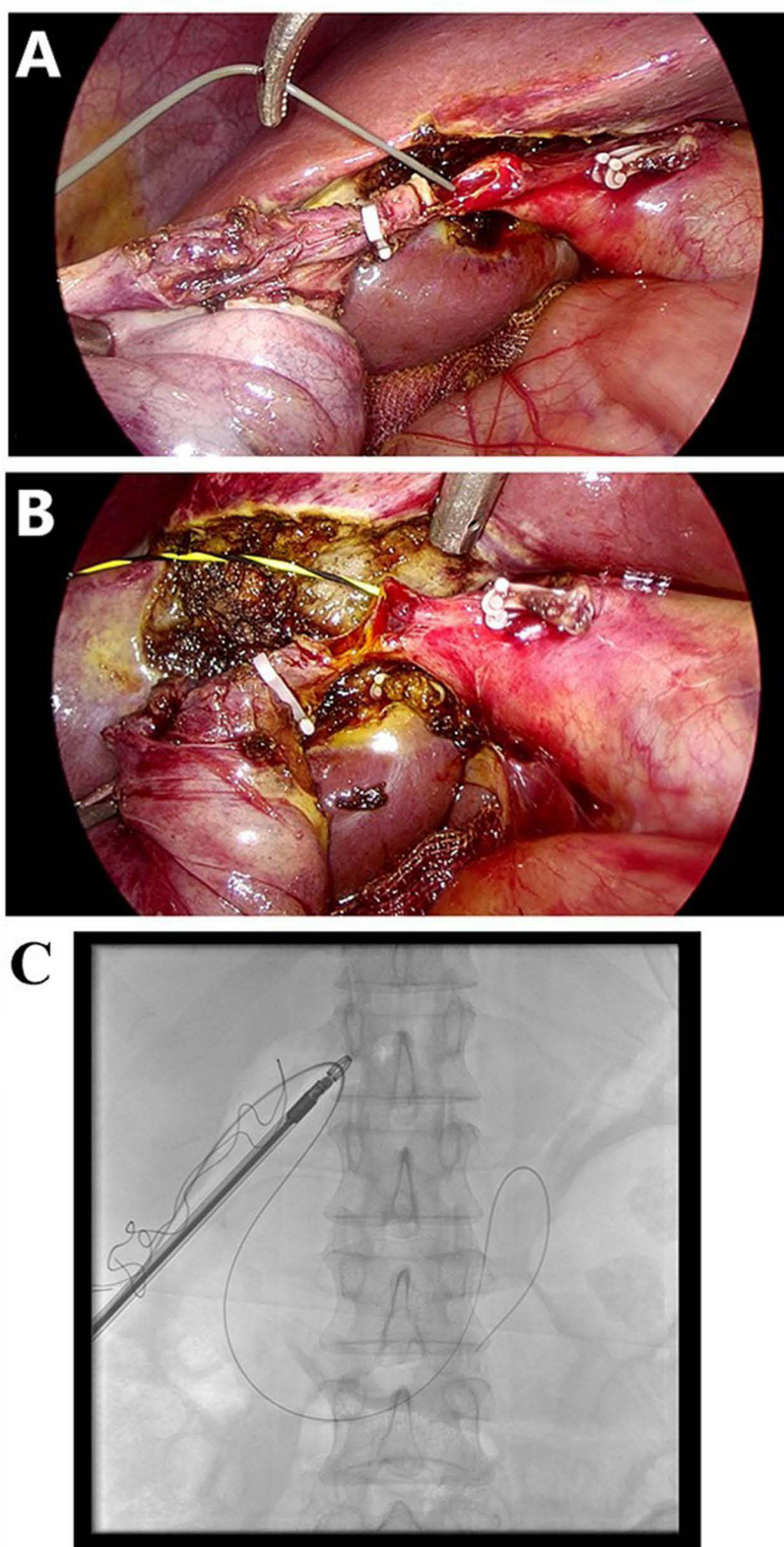


Figure 2 Group (A) Angiographic forceps-assisted cholangiography approach (A) The hydrophilic tip of zebra guidewire enters the cystic duct, (B) zebra guidewire enters CBD, (C) The X-ray after the guidewire enters the duodenum).

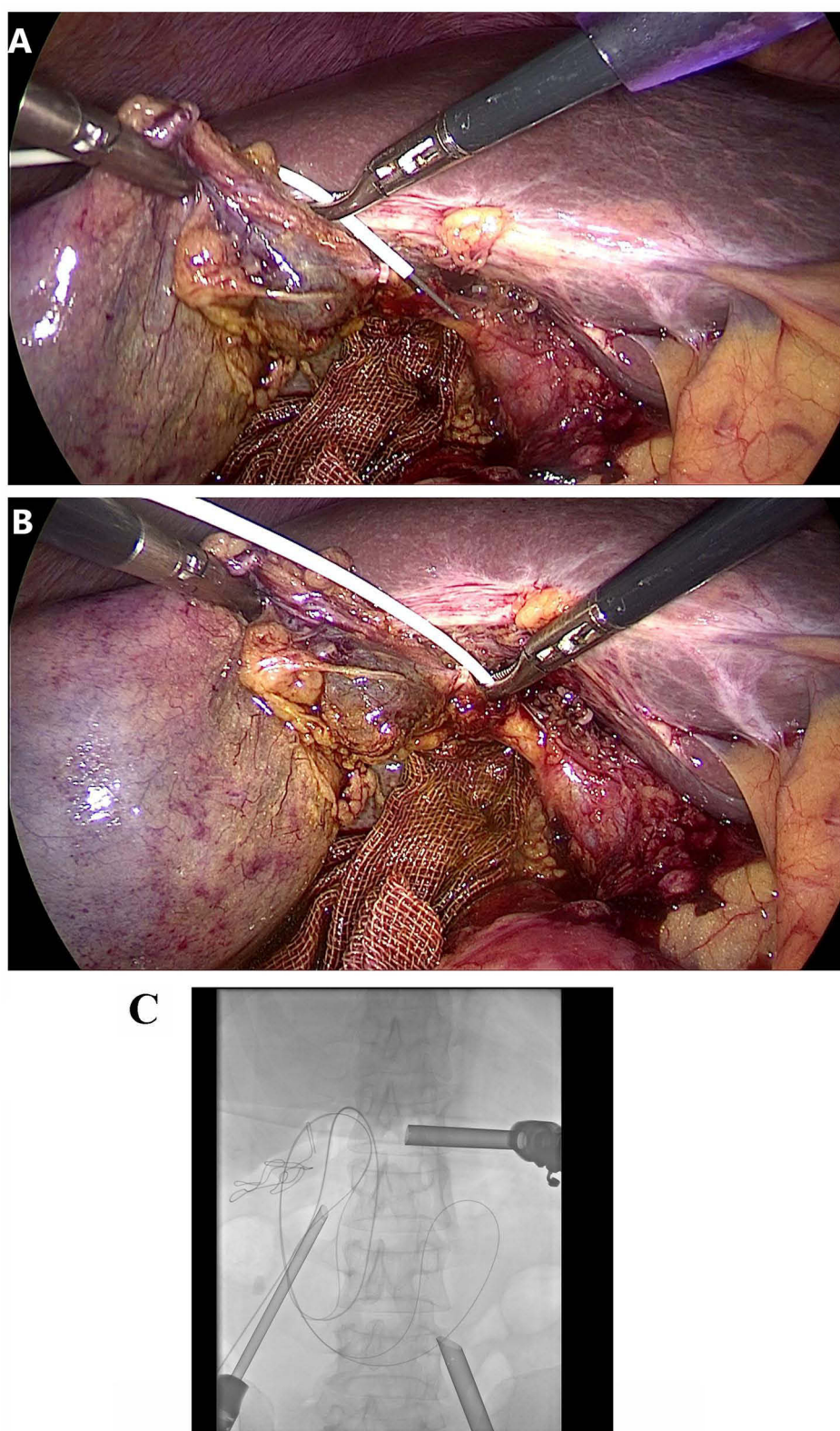


Figure 3 Group (B) Ureteral catheter-assisted cholangiography approach (A) The hydrophilic tip of zebra guidewire passes through the ureteral catheter and enters the cystic duct, (B) zebra guidewire enters CBD, (C) The X-ray after the guidewire enters the duodenum).

Table 1 Clinical Characteristics of 110 Patients With Cholecystolithiasis and Choledocholithiasis

	Group A (n=52)	Group B(n=58)	p
Age (year)	52.56±15.06	54.05±14.89	0.602
Sex (male/female)	25/27	31/27	0.574
Preoperative Biochemistry findings			
ALT (U/L)	239.13±245.54	232.03±214.06	0.874
AST (U/L)	182.96±287.71	182.04±207.17	0.985
TBIL (μmol/L)	30.63±25.04	46.06±37.2	0.003
Stone characteristics			
Diameter of stones (cm)	4.15±2.06	4.24±2.48	0.842
Diameter of CBD (cm)	8.58±2.56	8.47±2.61	0.822
Postoperative biochemistry findings			
Leukocyte (10⁹ /L)	11.23±3.7	10.37±3.7	0.228
ALT (U/L)	151.46±113.71	146.62±124.02	0.832
AST (U/L)	92.79±92.11	86.55±54.45	0.663
TBIL (μmol/L)	29.13±16.52	37.81±26.71	0.046
Amylase (U/L)	175.4±303.22	201.62±333.11	0.668
Hospital stays (days)	8.04±3.19	7.45±2.6	0.288
Hospitalization costs(yuan)	23699.21±4313.73	23184.6±3790.18	0.507
Operation time (min)	170.5±46.89	154.55±39.09	0.054
Rendezvous cannulation time (min)	11.94±5.4	8.41±3.62	<0.001
Postoperative complications			
Pancreatitis (%)	1(2%)	0	0.473*
Hyperglycaemia (%)	15 (28.8%)	15 (25.9%)	0.726
Peritoneal infection (%)	2(4)	0	0.221*
Pulmonary embolism (%)	1(2%)	0	0.473*

Note: *Fisher's exact test.

Abbreviations: ALT, alanine aminotransferase; AST, aspartate aminotransferase; TBIL, total bilirubin, CBD, common bile duct.

Follow-up was completed in all 110 patients for a duration of 1 to 45 months (median = 17 months). No cases of recurrent abdominal pain, jaundice, biliary stricture, or residual stones were reported following discharge. One case of recurrent choledocholithiasis occurred in each group. No surgery-related mortality was observed (Table 1).

Discussion

Approximately 15% of patients with cholelithiasis develop concomitant choledocholithiasis, which represents the most frequent indication for ERCP. The laparoscopic-endoscopic rendezvous technique, which combines laparoscopic cholecystectomy with ERCP, has been shown to be effective and safe for managing cholelithiasis with concomitant choledocholithiasis, with a low incidence of complications, particularly post-ERCP pancreatitis.^{8,9} Despite this, post-ERCP pancreatitis remains the most common adverse event, with an incidence of 10.2% and an associated mortality rate of 0.2% due to pancreatic necrosis.¹⁰

The most critical step in the intraoperative ERCP procedure is the successful placement of the yellow zebra guidewire from the cystic duct opening into the duodenal lumen. The first step is to introduce the guidewire from outside the body into the abdominal cavity. In this study, we passed the ureteral catheter (intervention group) through the trocar first, fixed its tip with a laparoscopic grasper, then removed the trocar and re-inserted it alongside the catheter through the original abdominal wall puncture site. This allowed the catheter to enter the abdominal cavity through the gap beside the trocar. Compared to directly passing the guidewire through the abdominal wall or guiding it with angiographic forceps, inserting the guidewire through the ureteral catheter generates less friction, making it easier to control the insertion angle (Figure 4).



Figure 4 Antegrade placement of the yellow zebra guidewire via the ureteral catheter.

The second step involves advancing the guidewire from the cystic duct opening into the CBD. From an anatomical perspective, successful catheterization is influenced by factors such as the course of the cystic duct, its diameter, the angle of its junction with the CBD, the presence of stones impacted at the cystic duct opening, and cystic duct stenosis. In the intervention group, we inserted the ureteral catheter directly into the cystic duct—and in some cases, even into the CBD itself. The soft, hydrophilic tip of the guidewire could then traverse the spiral folds (valves of Heister) of the cystic duct, allowing smooth placement into the CBD. However, during the procedure, we observed that both groups could potentially create a false passage in the cystic duct during catheterization. Possible reasons include: 1. inadvertent injury to the cystic mucosa during blunt dissection or dilation of the duct with forceps; 2. forceful catheter or guidewire insertion after repeated unsuccessful attempts, leading to perforation of the cystic mucosa; 3. an excessively long remaining cystic duct segment, which may cause the guidewire to recoil from the spiral valve structures. Factors that appear favorable for successful guidewire insertion include: retracting the cystic duct to an acute angle, shortening the residual length of the cystic duct, inserting the ureteral catheter in the intervention group to approximately the midpoint of the remaining cystic duct length, and selecting a yellow zebra guidewire with a short hydrophilic tip.

The third step involves advancing the guidewire from the CBD into the duodenal lumen. Since the guidewire's trajectory within the CBD cannot be visualized directly, it is crucial to control its insertion angle from the cystic duct. Inserting at an acute angle relative to the common hepatic duct facilitates guidewire advancement toward the CBD orifice. The assistant must estimate the length of guidewire advancement within the CBD, pay attention to resistance transmitted via the guidewire during advancement, and avoid blind, forceful pushing. If resistance is encountered, the guidewire should be slightly withdrawn and then readvanced. Otherwise, the guidewire may recoil into the intrahepatic bile ducts or cause perforation. In this study, five patients in the control group experienced failed antegrade guidewire intubation; however, all were successfully managed with ureteral catheter assistance. In the intervention group, only one patient experienced failure of intubation, which was subsequently completed using conventional ERCP. In the control group, the failure of cannulation in five cases was attributed to the excessive softness of the hydrophilic tip of the guidewire, which made it difficult to adjust the direction appropriately with angiographic forceps or dissecting forceps for entry into the cystic duct. Even when the guidewire was successfully advanced into the CBD, it remained challenging to adjust the angle to allow the guidewire to smoothly exit through the CBD orifice. Switching to a ureteral catheter

provided guiding and supportive functions for the guidewire. By adjusting the direction of the catheter, the angle of the guidewire entering the cystic duct could be easily optimized to an acute angle, facilitating its entry into the CBD. Once the catheter was inserted deep enough into the cystic duct, it effectively prevented the guidewire from being deflected by the spiral folds of the cystic duct.

The shorter guidewire intubation time and higher success rate in the intervention group may be attributed to the limitations of forceps manipulation in the control group, as the soft guidewire tip reduces clamping efficacy and hinders precise navigation. The ureteral catheter in the intervention group provided a supportive conduit, guiding the wire more effectively toward the duodenal papilla. In cases where the guidewire coiled within the bile duct, gradual advancement of the catheter allowed it to support and realign the guidewire, enabling passage through narrow spaces between the bile duct wall and calculi. The flexibility of the ureteral catheter allowed it to conform to the bile duct anatomy, improving maneuverability and enabling smoother entry into the CBD.

In the abdominal cavity, separation forceps were used to adjust the direction of the ureteral catheter, thereby improving guidewire orientation and increasing the likelihood of successful duodenal entry. When the guidewire was inserted through the side wall of the cystic duct, the presence of mucosal folds (plicae) reduced forward tension during advancement. The ureteral catheter provided additional structural support, facilitating successful guidewire passage into the CBD. Postoperatively, no cases of acute pancreatitis were observed in the intervention group, whereas one case occurred in the control group, findings consistent with previous reports.^{11–13} These findings support the utility of ureteral catheter assistance in improving guidewire success rates.

In contrast, the control group demonstrated a higher incidence of postoperative complications. Notably, patients who developed complications were not older adults, and all had indwelling abdominal drainage tubes following surgery. Although these complications may not have been directly attributable to the guidewire intubation technique, the use of a more efficient and less traumatic approach may reduce total operative time, limit surgery-related stress and trauma, and thereby contribute to lower complication rates.

Although no statistically significant difference in postoperative serum amylase levels was observed between the two groups, levels in the intervention group were higher than those in the control group. This finding contrasts with the initial hypothesis. Previous studies have identified both procedure-related and patient-specific factors as contributors to ERCP-related complications.^{8,14,15} Procedure-related factors include repeated intubation attempts, unintended pancreatic duct entry or contrast injection, precut sphincterotomy of the papilla, and large-diameter balloon dilation. Patient-specific factors include sphincter of Oddi dysfunction, younger age, female sex, a history of post-ERCP pancreatitis, and normal bilirubin levels.

Several possible explanations may account for the higher amylase levels in the intervention group: (1) the mean CBD diameter was slightly smaller in the intervention group compared to the control group (8.47 mm vs 8.58 mm), potentially contributing to duodenal papilla edema; (2) the mean diameter of the largest stone was slightly larger in the intervention group compared to the control group (4.24 mm vs 4.15 mm), which may have caused increased duodenal papilla irritation during stone extraction; (3) the firmer texture of the ureteral catheter may have stimulated the duodenal papilla during antegrade guidewire intubation, resulting in edema; and (4) the intervention group included a higher proportion of patients younger than 60 years.

Although the differences in hospitalization duration, operative time, and costs between the two groups did not reach statistical significance, all parameters were numerically lower in the intervention group. Furthermore, no significant surgery-related complications were observed in the intervention group, supporting the potential benefits of ureteral catheter-assisted antegrade intubation.

In summary, ureteral catheter-assisted antegrade intubation during the laparoscopic-endoscopic rendezvous procedure for patients with cholelithiasis and concomitant choledocholithiasis appears to be a safe and technically feasible approach. Potential benefits include procedural convenience, reduced operative time, fewer complications, and enhanced postoperative recovery. However, the limitations of this study included its relatively small sample size, single-center design, and retrospective nature. Future validation of this approach requires incorporating more data or designing larger-scale prospective studies, as well as conducting multicenter trials. Additionally, upon obtaining positive results, we intend to conduct comparative studies with laparoscopic cholecystectomy combined with ultrafine choledochoscopy lithotomy via the cystic duct.

Highlights

Novel Technique: This study describes the first systematic application of a urological ureteral catheter to facilitate antegrade guidewire intubation during the laparoscopic-endoscopic rendezvous procedure, offering a solution to a key technical challenge.

Improved Success Rate: Ureteral catheter assistance significantly increased the success rate of antegrade guidewire placement (98.3%) compared to the conventional forceps-guided method (91.2%).

Enhanced Efficiency: The technique substantially reduced the duration required for successful guidewire intubation, contributing to procedural efficiency.

Favorable Safety Profile: The ureteral catheter-assisted approach was associated with a lower incidence of post-procedure acute pancreatitis (0% vs 2% in controls) and other complications, demonstrating a promising safety advantage.

Clinical Feasibility: The findings support the technical feasibility, safety, and potential clinical benefits of this modified approach for managing concurrent gallbladder and common bile duct stones.

Abbreviations

CBD, Common bile duct; LC, Laparoscopic Cholecystectomy; ERCP, Endoscopic Retrograde Cholangio-Pancreatography; CT, Computed Tomography; MRCP, Magnetic Resonance Cholangiopancreatography; ALT, Alanine Aminotransferase; AST, Aspartate Aminotransferase; TBIL, Total Bilirubin.

Data Sharing Statement

All data generated or analyzed during this study are included in this article. Further enquiries can be directed to the corresponding author Wenlong Zhang.

Ethics Approval and Consent to Participate

This study was conducted with approval from the Ethics Committee of Taizhou Hospital of Zhejiang Province. The approval number is KL20240422. This study was conducted in accordance with the declaration of Helsinki. Written informed consent was obtained from all participants.

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Disclosure

The authors declare that they have no competing interests.

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