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Single Port Robotic assisted Cholecystectomy and Common Bile Duct Exploration: Initial Experience of a Novel Surgical Approach

Nim Choi, Chin Wan Leong, Chi Ian Kuok, Man Sang Lei, Ka Man Ng, Jose Costa Maia*

***Corresponding author:**
Jose Costa Maia, MD
Department of General Surgery, Centro Hospitalar Conde de São Januário (CHCSJ), Macau S.A.R. China
E-mail: costamaia57@gmail.com

Department of General Surgery, Centro Hospitalar Conde de São Januário (CHCSJ), Macau S.A.R., China

ABSTRACT

Background: The present study aims to review the feasibility, safety and short-term outcome of single port robotic-assisted cholecystectomy with common bile duct (CBD) exploration for complicated biliary stone with the Da Vinci SP™ (Intuitive Surgical Inc., Sunnyvale, CA, USA) system.
Materials and Methods: Retrospective analysis of single port robotic-assisted cholecystectomy and CBD exploration for synchronous gallbladder (GB) and CBD lithiasis, between June and December 2024. Data on patient demographics, perioperative investigations, surgical procedure and postoperative outcomes were retrospectively collected.
Results: Five consecutive patients were identified, including three males and two females. The median age was 74 (49–89) years. Median BMI was 23.3 (20-24.2). Median total bilirubin was 37 umol/L (16–56). Median CBD diameter was 10 mm (7-15). Four patients underwent emergency surgical procedures, and one underwent elective surgery. Median operative time was 176 (76–365) minutes. Total bleeding was within 10 ml. The clearance rate of common bile duct stones was 100%. No peritoneal or biliary drainage was used. No postoperative complications were recorded, and the median postoperative length of stay was 5 (1–8) days.
Conclusion: Our initial experience confirmed that single port robotic assisted cholecystectomy and CBD exploration is feasible, safe and effective treatment for synchronous GB and CBD lithiasis. Additionally, single port robotic system provides better cosmetic results, less postoperative wound pain than conventional robotic systems and may reduce the learning curve for complex procedures.
Keywords: gallstones, biliary lithiasis, common bile duct exploration, single port, robotic surgery

INTRODUCTION

In the 21st century, the pooled global prevalence and incidence of gallstones is about 6.1% and increases with age (1). The incidence of CBD stones is 10-20% (2) in symptomatic gallstone patients and 13.7% in patients with acute cholecystitis (3). Some predictors of CBD lithiasis in patients with gallstones include CBD diameter and elevation of GGT, ALP and ALT, with GGT considered as the most reliable predictor of CBD stone in acute cholecystitis (3). One-stage approach for the treatment of synchronous GB and CBD stones includes cholecystectomy and

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CBD exploration and stone extraction or intraoperative endoscopic retrograde cholangiopancreatography (ERCP) and cholecystectomy. The classical two-stage approach consists of upfront ERCP and subsequent cholecystectomy. Although both strategies appear equally valid treatment options (2,4) single-stage laparoscopic CBD exploration with cholecystectomy may be superior for stone clearance (5). While safety and effectiveness of robotic assisted CBD exploration for the treatment of choledocholithiasis has been established (6), there is, to our knowledge, no report on the safety of single port robotic assisted approaches, prompting the authors to review their initial experience on the feasibility, safety and short-term outcome of this technique with the Da Vinci SP system.

MATERIAL AND METHODS

From June 2024 to December 2024, five consecutive patients (3 M, 2 F) underwent single port robotic-assisted cholecystectomy and CBD exploration in our Center, four as emergency and one as elective procedure. Data on patient demographics, perioperative investigations, surgical procedures and postoperative outcomes were retrospectively analyzed and are shown in *table 1*.

Collected parameters included demographic data (sex, age and BMI), total bilirubin, CBD diameter operative data and post-operative outcomes. Surgical data included operative time, blood loss, completeness of stone clearance. Length of postoperative stay, morbidity or mortality and pathology results were also analyzed.

The median age was 74 (49-89) years. Median BMI was 23.3 (20-24.2). Median total bilirubin was 37 umol/L (16–56 umol/L). Median CBD diameter was 10 mm (7-15 mm). All patients underwent pre-operative imaging assessment with CT scan.

SURGICAL PROCEDURE

Under general anesthesia, the patient was placed in a supine position with arms tucked along the body. A

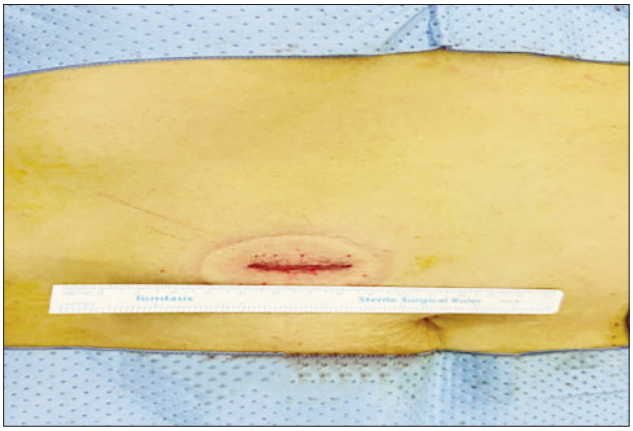

Figure 1 - Right upper abdomen wound

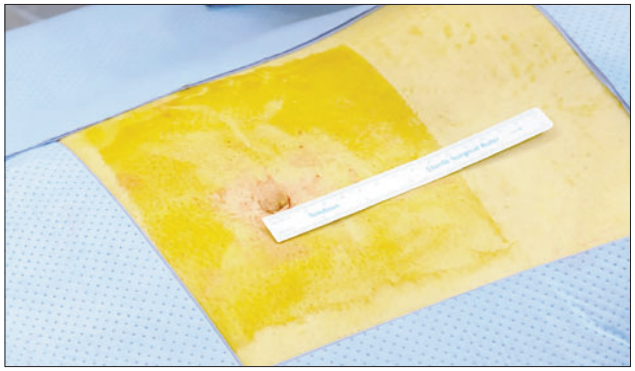

Figure 2 - Paraumbilical wound

3-cm transverse incision was made in the right upper abdomen (the first two cases) or paraumbilical incision about 2.7 cm (current routine) (*figs. 1, 2*). Entered the peritoneal cavity with open technique and an Access Port ((Intuitive Surgical Inc., Sunnyvale, CA, USA) with a 27-mm port for the multichannel SP trocar, a 12-mm assistant port, and two 5-mm assistant ports was introduced. The patient was tilted to the left side with head up just as routine laparoscopic cholecystectomy position. The Da Vinci SP system was positioned on the patient's right side (*fig. 3*). A camera was set as above mode, a Cadiere forceps ((Intuitive Surgical Inc., Sunnyvale, CA, USA) introduced at the bottom (arm 2), monopolar curved scissors on the right (arm 3), and fenestrated bipolar forceps on the left (arm 1) of the

Table 1 - Demographic data

Case	Sex	Age	BMI	Pre-Op TBil	Post_Op TBil	CBD
1	M	75	22.8	16	20	10 mm
2	F	49	24.2	44	13	7 mm
3	M	74	23.3	37	15	10 mm
4	M	89	20	28	10	15 mm
5	F	67	23.6	56	15	11 mm

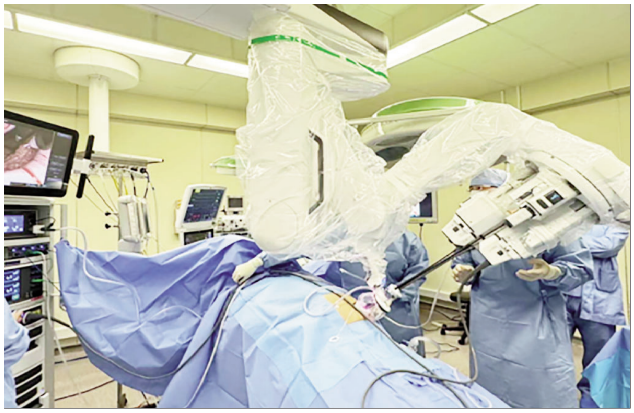

Figure 3 - Docking

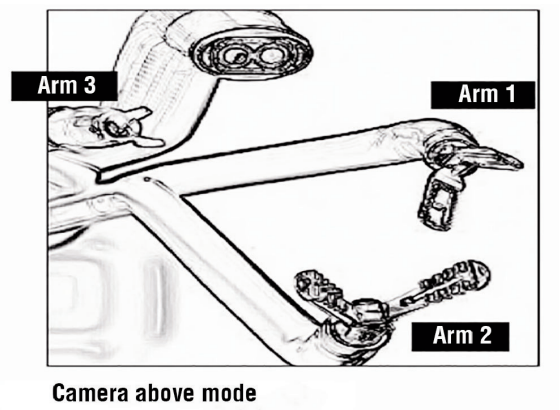

Figure 4 - Arms setting

multichannel SP trocar (*fig. 4*). One subhepatic small gauze is inserted, as well as one sterile nasogastric tube with side orifice, introduced through a side hole of the access port and connected to suction.

Cholecystectomy was initially performed with the routine dissection of Calot's triangle and critical view of safety. The cystic artery was coagulated by fenestrated bipolar forceps and divided by monopolar scissor or ligated by a 4-0 Polysorb (Covidien, Dublin, Ireland) ligation, and the cystic duct divided over 5mm Hem-o-Lok or 4-0 Polysorb ligation. The common bile duct was exposed and a longitudinal choledochotomy created with robotic scissors (*fig. 5*).

Cholangioscopic exploration was performed with a 4 mm OD disposable flexible cystoscope (*fig. 6*).

Instead of a conventional cholangioscope, the authors prefer a disposable flexible cystoscope with an equally large working channel, easily inserted into the CBD with robotic instrument guidance, allowing for the incision at the umbilicus, with better cosmetic results (*figs. 1, 2*). Additional advantages include lesser risk of cross infection and reduced costs when compared to other single use cholangioscopes. The CBD was cleared by stone extraction with basket (*fig. 7*). One patient with a large distally impacted stones required laser lithotripsy for stone fragmentation and extraction that significantly prolonged the operative time.

All stones or debris were placed over a gauze and retrieved to an endobag. Control cholangioscopy was performed to confirm CBD clearance, and the choledochotomy was primarily closed with a running 4-0 V-loc suture (*fig. 8*). No intra-abdominal or biliary drainage was routinely used, and the wound was closed with subcutaneous continuous suture.

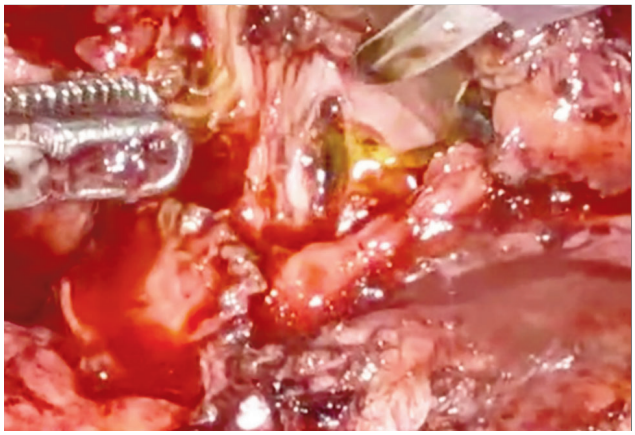

Figure 5 - Longitudinal choledochotomy with scissors

Figure 6 - Scope introduced into CBD

RESULTS

All five cases were successfully completed, with no requirement for extra trocars or conversion. Common bile duct clearance was achieved in all patients.

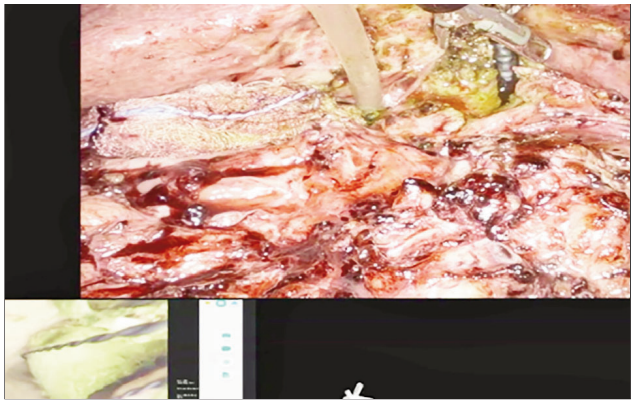

Figure 7 - Picture in picture for cholangioscopy. Right lower photo demonstrated CBD stone retrieval

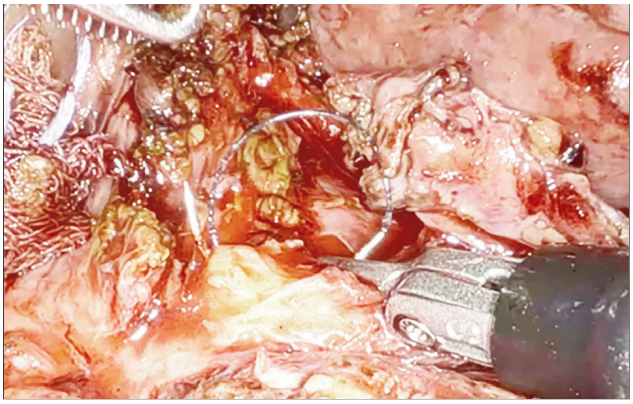

Figure 8 - Primary closure choledochotomy with 4-0 V-Loc

Operative and post-operative parameters are shown in *table 2*. Median operative time was 176 (76–365) minutes. Estimated blood loss was 10 ml. Median postoperative length of stay was 5 (1–8) days. Pathology included one Xanthogranulomatous cholecystitis, two chronic cholecystitis, one acute cholecystitis and one acute on chronic cholecystitis.

No postoperative complication was recorded. No residual stone or early CBD stenosis were detected by image and blood test controls during the short follow-up.

DISCUSSION

The choice of treatment for synchronous GB and CBD lithiasis depends on several factors including patient's condition, the presence of severe complications such as cholangitis or pancreatitis, and locally available logistics and expertise. Some authors suggest early endoscopic or percutaneous biliary drainage when patients present with cholangitis or pancreatitis (7,8). In our experience, even cases with mild cholangitis according to TG 18 guidelines (9). can be safely treated by the present approach. The median operation time was comparable to conventional robotic assisted cholecystectomy and CBD exploration (6).

Choledochotomy has classically been associated to short-term complications, namely bile leaks and retained calculi and long-term biliary strictures. None of them were observed in the short follow-up of the patients in the present series. We naturally keep them in close observation for any long-term complication, especially the appearance of choledochotomy-related stricture.

Compared to laparoscopy, single-port robotic surgery shares the advantages of conventional robotics, namely 3-D, image magnification, stable platform and articulated instruments that provide greater visualization, enhanced dexterity and greater precision.

Compared to conventional robotic systems, the docking procedure of the SP is simpler, needing only a few minutes. Single port robotic surgery is also associated with reduced trauma, less pain and better cosmetic results (10,11). As a significant drawback, the single port robotic system only provides Monopolar and Bipolar electrocautery. However, most procedures can be completed with these devices.

Table 2 - Perioperative data

Case	Operation time minutes	Length of postoperation stay	Elective/ urgent surgery	Pathology
1	75	1 days	Elective	Chronic cholecystitis
2	119	9 days	urgent	Chronic cholecystitis
3	176	8 days	urgent	Acute cholecystitis
4	365	6 days	urgent	Xanthogranulomatosis Cholecystitis
5	210	7days	urgent	Acute on chronic cholecystitis

CONCLUSION

The authors believe that single port robotic assisted cholecystectomy and CBD exploration is feasible, safe and effective treatment for synchronous gallbladder and CBD lithiasis, even in patients with mild cholangitis.

Conflicts of Interest

The authors have no conflicts of interest.

Declaration of Patient Consent

The authors certify that they have obtained all appropriate patient consent forms. In the form the patient(s) has/have given his/her/their consent for his/her/their images and other clinical information to be reported in the journal. The patients understand that their names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

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