Choledochoscopy using disposable bronchoscope Ambu aScope 3: a single-institute experience

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Received: 17 May 2021
Revised: 27 May 2021
Accepted: 4 June 2021
Published: 11 January 2022

The Egyptian Journal of Surgery 2021, 40:1000–1005

Context
Laparoscopic common bile duct (CBD) exploration has become an increasingly popular procedure with favorable outcomes when performed by experienced surgeons. This study shows our institution's experience using a disposable bronchoscope for choledochoscopy and CBD clearance in cases of choledocholithiasis.

Aims
To evaluate the possibility, practicability and efficacy to use the disposable bronchoscope in laparoscopic CBD exploration.

Patients and methods
A total of 50 patients diagnosed with choledocholithiasis underwent laparoscopic transcholedochal CBD exploration performed with choledochoscopy using an Ambu aScope 3 disposable bronchoscope.

Statistical analysis used
Data were analyzed using IBM SPSS software package version 20.0. (Armonk, NY: IBM Corp).Qualitative data were described using number and percent. Quantitative data were described using range (minimum and maximum), mean, standard deviation, and median.

Results
Successful biliary clearance was achieved laparoscopically in 45 patients. Conversion to open surgery was deemed mandatory in four patients owing to difficult biliary anatomy or distal impacted stones, whereas one patient required laparoscopic choledochoduodenostomy. None of the converted cases were attributed to equipment failure, and no cases of equipment-related postoperative complications occurred.

Conclusions
The Ambu aScope 3 is a feasible, easy to use, portable, and disposable bronchoscope that can be safely implemented in surgical biliary visualization.

Keywords:
common bile duct stones, choledocholithiasis, disposable bronchoscope, laparoscopic common bile duct exploration

Egyptian J Surgery 40:1000–1005

1110-1121

Introduction

Choledocholithiasis [common bile duct (CBD) stones] has an overall prevalence of 10–20% among patients with gallstones [1], with treatments involving either endoscopic [via endoscopic retrograde cholangiopancreatography (ERCP))] or surgical management (via laparoscopy or conventional open surgery) [2].

The laparoscopic management is gaining popularity as surgeons have become increasingly skilled [3]. Laparoscopic CBD explorations are performed either transcystically or via direct choledochotomy [4]. The transcystic approach in our institute is mostly reserved for patients with a few (<5), small (<5 mm) stones, a dilated cystic duct, or a normal-caliber CBD, and it mandates the presence of choledochoscopic visualization of the biliary system to aid in stone extraction and ensure biliary vacuity.

Disposable bronchoscopes are used in cases of difficult intubation or bronchoscopy; few surgeons have implemented this tool in biliary visualization instead of standard choledochoscopes [5,6]. The Ambu aScope 3 disposable bronchoscope features three different diameters – large (5.8 cm), medium (5.0 cm), and slim (3.8 cm) – and corresponding working channels of 2.8, 2.2, and 1.2 cm, respectively.

Here, we describe our experience using the Ambu aScope 3 to aid biliary clearance in a set of laparoscopic CBD explorations.

Patients and methods

This study included 50 patients diagnosed with CBD stones at our institute between January 2019 and May 2020. Patients were diagnosed via radiologic examination using ultrasonography, magnetic resonance cholangiopancreatography, or computed tomography. All patients provided informed consent according to the ethical guidelines of the Medical Research Institute of Alexandria University.

Exclusion criteria

The following were the exclusion criteria:

(1) Suspected biliary, pancreatic, or hepatocellular malignancies.
(2) CBD diameter less than 8 mm.
(3) Medical history of uncontrolled ischemic heart disease, chronic renal or liver disease, or uncontrolled bleeding disorders.
(4) American Society of Anaesthesiology classes IV and V diseases.
(5) Current pregnancy.
(6) Clinical or radiological evidence of suppurative or necrotizing cholecystitis, gallbladder empyema, gallbladder perforation, severe cholangitis, or pancreatitis.
(7) Radiological evidence of pancreatic cholelithiasis or pancreatic divisum.

All patients fasted for 8 h before surgery, and intravenous antibiotics (third-generation cephalosporins) were administered 1 h before the start of surgery.

Under general anesthesia, four ports were inserted as in classical laparoscopic cholecystectomy with the surgeon and the assistant standing on the patient's left side. After a transcystic cholangiography was performed, a direct choledochotomy was performed using a laparoscopic scissors or hook.

An Ambu aScope 3 (NASDAQ OMX Copenhagen, Denmark) was introduced into the CBD via the epigastric subxiphoid or the right subcostal port. Visualization of the biliary tract was achieved using saline irrigation via the scope. Stone extraction was achieved using either an endoscopic Dormia basket or endoscopic balloon extraction, both of which were delivered through the scope's 2.8-mm working channel (Fig. 1).

The Ambu aScope 3 was reintroduced to ensure biliary vacuity both distally and proximally (Fig. 2).

The choledochotomy was closed directly with interrupted absorbable sutures or over a T-tube according to the surgeon's preference. A tube drain was routinely placed in the subhepatic space in all patients.

A T-tube cholangiogram was performed on the 14th postoperative day in patients with a T-tube.

All patients were followed up for 6 months. The primary end point was CBD clearance. The cause of the failed CBD clearance was analyzed to determine its relationship with instrument failure. The secondary end point was the assessment of postoperative complications and their relationship to the used instrument. Postoperative complications were graded according to the Clavien-Dindo classification [7].

Results

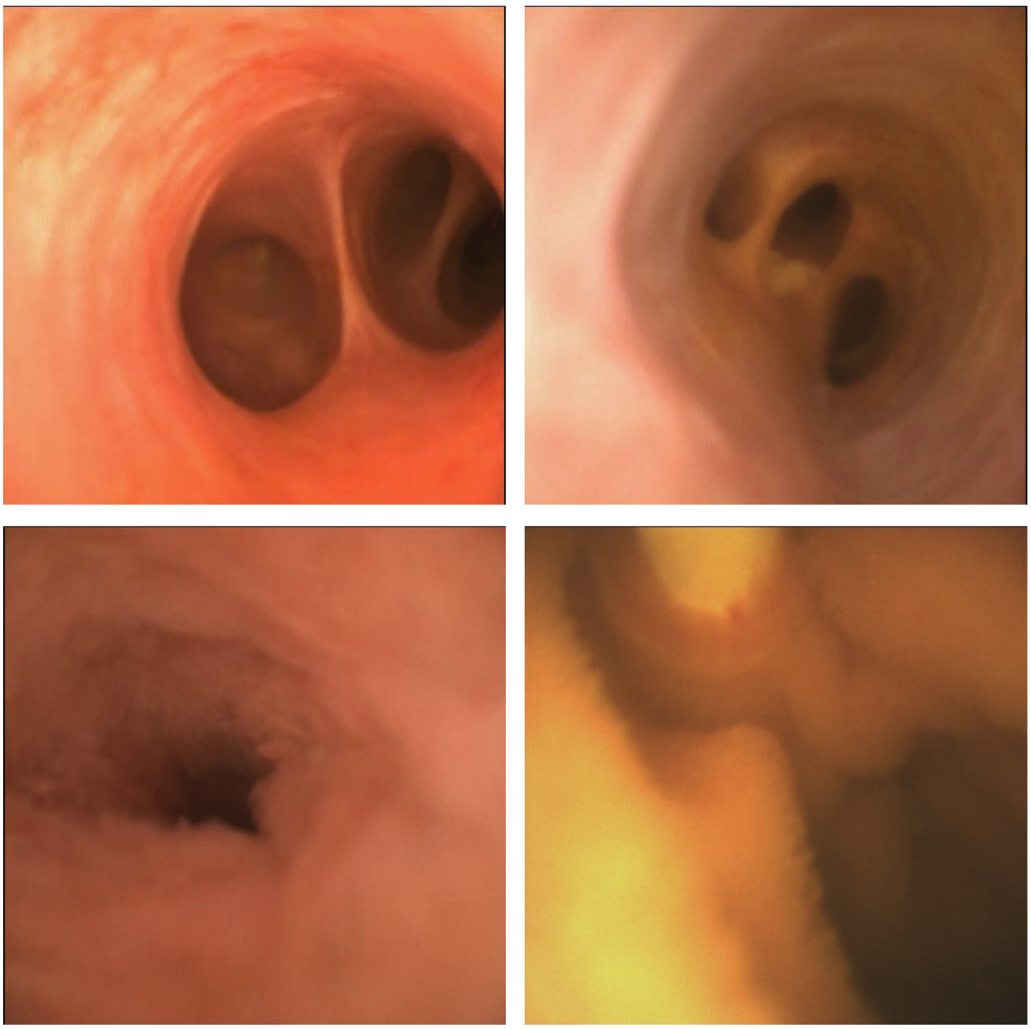
The mean age of the study group was 56.6±15.8. years, with a slight female predominance of 54% (27 women). Overall, 16% of the patients had a history of failed ERCP cannulation, whereas 58% had a history of failed ERCP stone extraction.

The mean total hospital stay duration of our study group was 2.36±1.31 days. The patients primarily demonstrated pain (44%), jaundice (38%), and fever (8%). Preoperative ultrasound showed a normal CBD in 12% of the patients, dilated with no stones in 14%, and dilated with documented stone(s) in 74%. Magnetic resonance cholangiopancreatography was performed in 92% of cases to confirm the presence of stones in equivocal patients. Intrahepatic biliary dilatation was confirmed via radiologic examination in 92%. On laparoscopic exploration, the CBD stones were multiple in 56% of patients and single in 44%. The mean stone size was 13.49±5.03 mm, whereas the mean diameter was 14.71±4.89 mm. The mean total operative duration was 141.28±51.29 min.

Table 1 shows the study patients' demographic and preoperative data.

Laparoscopic CBD clearance was achieved in 45 (90%) patients and failed in the other five. One of the aforementioned five patients underwent successful laparoscopic choledochoduodenostomy, whereas the other four (8%) required the conversion to open surgery via a right subcostal incision owing to difficult biliary anatomy caused by a severe inflammatory process (one patient) or failed stone extraction owing to distal stone impaction (three patients).

Figure 1



Ambu aScope 3-guided Dormia or balloon extraction of common bile duct stones.

Converted cases ended either by digital stone crushing and extraction (three patients) with T-tube insertion or side-to-side choledochoduodenostomy (one patient). Direct CBD closure was performed in 36 patients, whereas closure with T-tube drainage was achieved in 12. The remaining two patients underwent bilioenteric bypass as previously mentioned.

Biliary visualization was achieved successfully in all patients using the Ambu aScope 3.

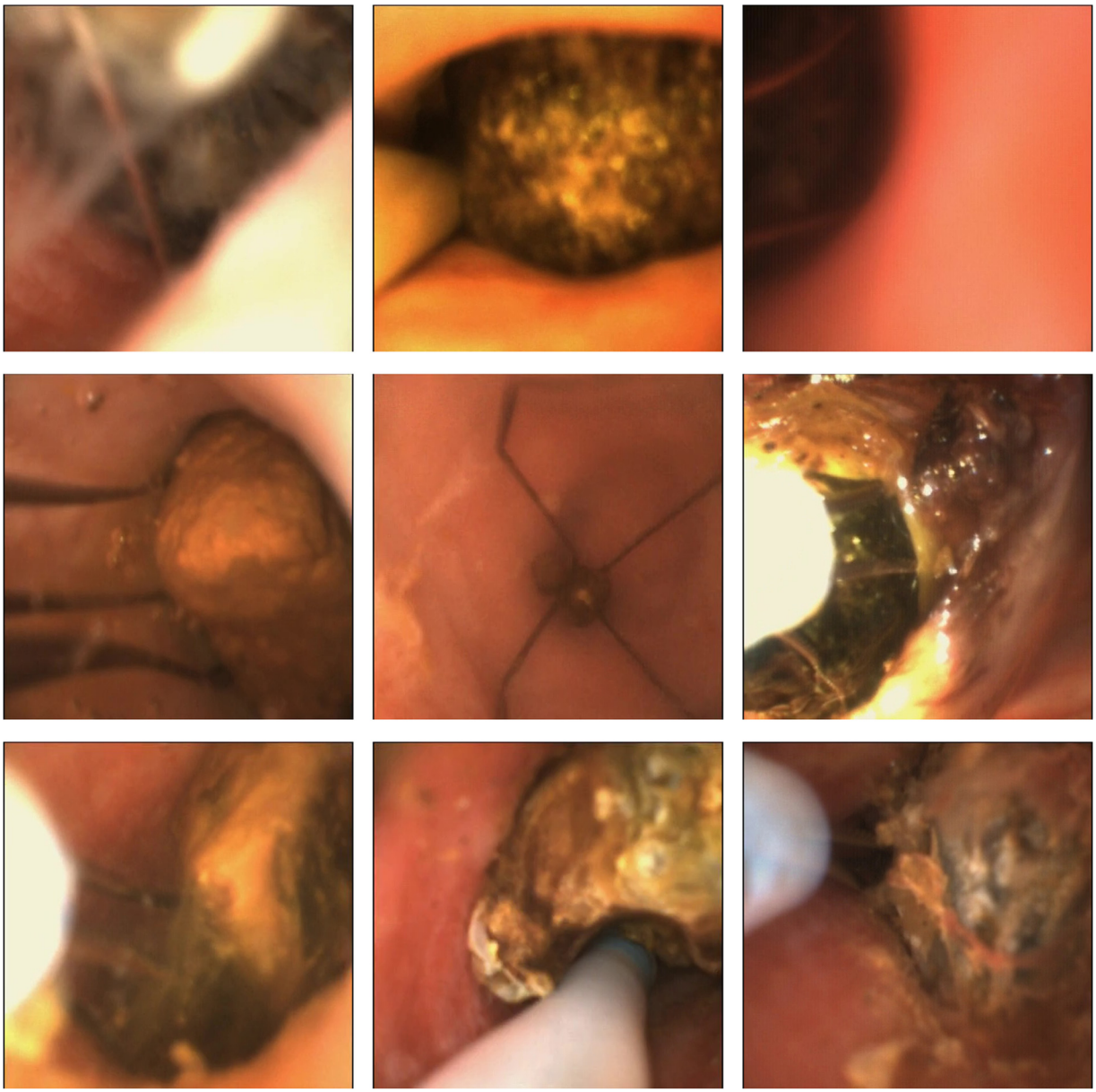
Postoperative complications occurred in 20 (40%) patients: class I in 17, class II in one, and class III in two. No cases of mortality occurred. Class I complications did not require hospitalization and included minor self-limiting bile leaks (10 patients) and trocar site wound infections (six patients). One patient had postoperative emphysema.

Table 2 shows the operative data of the study patients.

Class II complications occurred in one patient, who developed postoperative cholangitis manifested by jaundice, fever, abdominal pain, and ileus. No radiological evidence of abdominal collections or bile was noted in this patient. Treatment included bowel rest, parenteral antibiotics, and partial parenteral nutrition until the patient was discharged 5 days later.

Class III complications were noted in two patients. One patient developed class IIIa complications in the form of postoperative abdominal collection diagnosed by the presence of abdominal pain, ileus, low-grade fever, and an ultrasound showing a moderate free collection. Ultrasound-guided drainage of the collection was performed under local anesthesia and draining of clear bile, and no further interventions were required. A class IIIb complication occurred in a second case, which was owing to T-tube-related morbidity, in which postoperative jaundice, abdominal pain, fever, and bile leak into the tube

Figure 2



Proximal and distal biliary clearance confirmation and scope passage into the duodenum.

drain were noted with minimal T-tube outflow. A T-tube cholangiogram on the second postoperative day showed nonpassage of the dye into the proximal biliary system, and contrast extravasation around the T-tube was noted. The patient was managed by urgent ERCP and biliary stenting with removal of the incriminated T-tube.

The aforementioned complications were not related to the instrument; rather, they were mostly related to the surgical technique.

The mean total hospital stay duration was 2.36±1.31 days (range, 1–8 days).

Table 3 shows the distribution of postoperative complications.

Discussion

Laparoscopic CBD exploration is an important procedure in the management of choledocholithiasis, especially in the setting of concomitant gallstones [4].

Despite the advances in cholangiography, choledochoscopy is a nonreplaceable step of laparoscopic CBD exploration and has the advantages of videoscopy-guided stone management and better image quality.

Table 1 Demographic and preoperative data of the study patients

Study patients (*N*=50)	
Age (years)	56.64±15.86
Sex	
Male	23 (46)
Female	27 (54)
Symptoms	
Pain	44 (88)
Current or previous jaundice	38 (76)
Fever	8 (16)
Ultrasound CBD findings	
Normal	6 (12)
Dilated with no stones inside	7 (14)
Dilated with stone(s) inside	37 (74)
MRCP	46 (92)
IHBD	46 (92)

Values are shown as mean±SD or *n* (%). CBD, common bile duct; IHBD, intrahepatic bile duct; MRCP, magnetic resonance cholangiopancreatography.

Table 2 Operative data of the study patients

Number of CBD stones	
1	22 (44)
2	10 (20)
3–4	7 (14)
>5	11 (22)
Stone size (mm)	
Minimum–maximum	6.0–30.0
Mean±SD	14.71±4.89
CBD clearance	45 (90)
Conversion to open surgery	4 (8)
Total operative duration	
Minimum–maximum	35.0–298.0
Mean±SD	141.28±51.29
CBD closure technique	
Direct closure	36 (72)
T-tube insertion	12 (24)
Bilioenteric bypass	2 (4)

Values are shown as *n* (%) or mean±SD unless noted otherwise. CBD, common bile duct.

Table 3 Distribution of postoperative complications

Patients with postoperative complications (*N*=20)	
By Clavien-Dindo classification	
Class I	17 (85)
Class II	1 (5)
Class IIIa	1 (5)
Class IIIb	1 (5)
By complication	
Bile leak	10 (50)
Superficial port site infection	6 (30)
Fever	4 (20)
Surgical emphysema	1 (5)
Jaundice	2 (10)
Abdominal collection	1 (5)

Values are shown as *n* (%).

Rigid choledochoscopy was used historically until the introduction of the flexible fiberoptic choledochoscope, which has become the standard of care for choledochoscopy [4,8].

Nevertheless, the relative nonpopularity of laparoscopic bile duct exploration has been attributed to the use of flexible reusable choledochoscopes. This finding is mainly attributed to the difficult setting of such scopes and damage-induced repeated scope failure.

This drew attention to the disposable plastic scope mainly used for bronchoscopy, which is currently commercially produced under the name Ambu aScope and features several versions [6]. The Ambu aScope 3 was used in the current study.Our results were very encouraging and even superseded our expectations regarding the instrument's maneuverability and reliability. No instrument-related surgical failures or complications were documented.

The biliary clearance rate in our study was 90%, with a mean total operative time of 141.28±51.29 min, a finding that was consistent with the data published in several meta-analyses [9–11]. The main reason for conversion was stone impaction, which can be further improved upon using electrohydraulic or laser-based lithotripters.

Postoperative complications were mainly related to bile leak, superficial port site infection, and T-tube-related complications, with an overall complication rate of 40% that was not related to the instrument used.

These results are considered a breakthrough for safe, low-cost, and effective choledochoscopy with no risk of cross-infection or the instrument's maintenance-related disadvantages.

The Ambu aScope 3 is a feasible, cost-effective, portable, and safe disposable instrument for biliary visualization. Further larger trials are advised, especially with the advent of new disposable scopes.

Financial support and sponsorship
Nil.

Conflicts of interest
There are no conflicts of interest.

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