

Clinical Outcomes of Cholangioscopy as a Minimally Invasive Intervention for Common Bile Duct Stones

Septy Rianty Salsabilla Dwi Putri*, Reza Rizwandipa Wahyudi*, Devi Shanti Prameswari*, Rizky Ary Dwiandika*, Ridha Tahriani*, Ruhania Najwa Salsabila*, Cantika Brilian Sena*, Diaz Azhalea Jibriel*, Catarina Budyono**

*Student in the Medical Education Program at the University of Mataram, Indonesia's Faculty of Medicine and Health Sciences

**Department of Internal Medicine, Medical Education Study Program, Faculty of Medicine and Health Sciences, University of Mataram, Indonesia.

Corresponding author:

Septy Rianty Salsabilla Dwi Putri University of Mataram's Faculty of Medicine. Jl. Phone/facsimile: +62-822-3684-0792. E-mail:septyrianty29@gmail.com

ABSTRACT

Choledocholithiasis is a condition of obstruction in the bile duct due to stones, which is classified into primary and secondary. Primary choledocholithiasis occurs due to obstruction of bile flow that triggers stone formation, while the secondary form is caused by gallstones that have formed previously and moved to the common bile duct, causing obstruction. This condition can cause various serious complications that require different treatments. This article discusses the role of cholangioscopy as a minimally invasive intervention in the diagnosis and therapy of choledocholithiasis. The results of the study showed that cholangioscopy plays an important role in endoscopic therapy and lithotripsy. However, the availability of cholangioscopy equipment in Indonesia is still limited, so its current use is more as a supporting procedure for Endoscopic Retrograde Cholangiopancreatography (ERCP). The purpose of this study was to evaluate the clinical effectiveness of cholangioscopy in the treatment of choledocholithiasis, especially in complex cases that are difficult to treat with conventional methods.

Keywords : *Diagnosis, cholangioscopy, choledocholithiasis, therapy*

ABSTRAK

Koledokolitiasis adalah kondisi penyumbatan pada saluran empedu akibat adanya batu, yang diklasifikasikan menjadi primer dan sekunder. Koledokolitiasis primer terjadi akibat hambatan aliran empedu yang memicu pembentukan batu, sedangkan bentuk sekunder disebabkan oleh batu empedu yang telah terbentuk sebelumnya dan berpindah ke duktus biliaris komunis sehingga menyebabkan obstruksi. Kondisi ini dapat menimbulkan berbagai komplikasi serius yang memerlukan penanganan berbeda. Artikel ini membahas peran kolangioskopi sebagai intervensi minimal invasif dalam diagnosis dan terapi koledokolitiasis. Hasil studi menunjukkan bahwa kolangioskopi berperan penting dalam terapi endoskopi dan litotripsi. Namun, ketersediaan alat kolangioskopi di Indonesia masih terbatas, sehingga penggunaannya saat ini lebih bersifat sebagai prosedur penunjang dari Endoscopic Retrograde Cholangiopancreatography (ERCP). Tujuan dari penelitian ini adalah untuk mengevaluasi efektivitas klinis kolangioskopi dalam penanganan koledokolitiasis, khususnya pada kasus yang kompleks dan sulit ditangani dengan metode konvensional.

Kata kunci : *diagnosis, kolangioskopi, koledokolitiasis, diagnosis, terapi*

INTRODUCTION

A disorder known as choledocholithiasis occurs when obstructing stones cause a blockage in the bile duct. Choledocholithiasis affects around 10% of adults in the United States by prevalence. About 10%–20% of individuals with gallbladder stones develop choledocholithiasis, and research suggests that at least 3%–10% of patients undergoing cholecystectomy will also have common bile duct (CBD) stones. In addition, according to research conducted by Hartanto et al. (2021), the prevalence of choledocholithiasis in Indonesia is estimated to be around 5% of the general population, although this figure may vary depending on the region and age group studied.¹ This study demonstrates that factors such as obesity, high cholesterol diet, and family history play a crucial influence in the development of this disorder. Furthermore, a study by Pratama et al. (2022) found that choledocholithiasis is more common in older Indonesians as they age and that metabolic diseases like diabetes mellitus exacerbate the illness.²

Choledocholithiasis can result in severe complications that require immediate treatment, such as biliary obstruction, pancreatitis, and cholangitis. Traditional management of choledocholithiasis involves techniques such as Endoscopic Retrograde Cholangiopancreatography (ERCP), surgery, or a combination of both. However, with the advancement of medical technology, cholangioscopy has emerged as an effective and minimally invasive method for the diagnosis and treatment of choledocholithiasis. By directly visualizing the bile duct, cholangioscopy facilitates the detection of gallstones, strictures, and other anomalies. In addition, this procedure also allows for therapeutic interventions such as lithotripsy or real-time stone extraction. This review aims to explore the clinical outcomes, indications, and comparative effectiveness of cholangioscopy in the management of choledocholithiasis, particularly in complex or difficult-to-treat cases. This review aims to evaluate the clinical effectiveness of cholangioscopy in the treatment of choledocholithiasis, especially in complex cases that are difficult to treat with conventional methods.

LITERATURE REVIEW

Regarding the choledocholithiasis and the role of cholangioscopy in choledocholithiasis cases. In addition, to present evidence from clinical studies that support or question the role of cholangioscopy in choledocholithiasis cases.

GENERAL OVERVIEW OF CHOLEDOCHOLITHIASIS

Definition and Clinical Overview

Choledocholithiasis is defined as the presence of stones obstructing the common bile duct (CBD), which may arise primarily due to impaired bile flow or secondarily through migration of gallstones from the gallbladder. The condition affects approximately 10% of adults in the United States, and around 3%–10% of patients undergoing cholecystectomy will develop CBD stones. Additionally, 10%–20% of individuals with gallbladder stones may experience choledocholithiasis.³

Etiologically, choledocholithiasis is linked to bile stasis, infections, chemical imbalances, and excessive bilirubin production. Gallstones may form *de novo* in the CBD or migrate from intrahepatic ducts, as seen in rare cases of primary hepatolithiasis.⁴ Stones vary in composition cholesterol stones are most common, accounting for 75% of secondary CBD stones, while pigment stones (black or brown) are associated with bilirubin and bile pigment accumulation.⁴

Cholesterol supersaturation, elevated bilirubin, and gallbladder hypomotility are key factors in gallstone formation. These mechanisms cause bile to crystallize or stagnate, leading to obstruction.⁵ Clinically, symptoms include upper abdominal pain, jaundice, fever, nausea, and vomiting especially when stones cause biliary colic by blocking the duct. The pain may radiate to the shoulder or chest and often comes with digestive discomfort.⁶

Management of Choledocholithiasis

The treatment of choledocholithiasis is categorized into non-surgical and surgical approaches. Non-surgical management includes supportive care and dietary adjustments, with approximately 80% of patients recovering through rest, intravenous fluids, nasogastric suction, analgesics, and antibiotics. Oral dissolution therapy involves the administration of oral medication to break down gallstones, proving effective in about 60% of patients with stones measuring up to 20 mm in diameter. Another method, contact dissolution therapy, utilizes a solvent fluid introduced into the gallbladder through a percutaneous catheter via the liver or a nasobiliary catheter to dissolve stones. Methyl tert-butyl ether is commonly used as the dissolving agent and can effectively break down gallstones within

24 hours. Additionally, Extracorporeal Shockwave Lithotripsy (ESWL) employs high-intensity sound waves to fragment gallstones into smaller pieces.

The surgical treatment of cholelithiasis consists of two primary approaches: open cholecystectomy and laparoscopic cholecystectomy. Open cholecystectomy is the preferred option for patients with symptomatic cholelithiasis, although it carries a risk of complications such as bile duct injury. The most common indication for this procedure is recurrent biliary colic, followed by acute cholecystitis. Cholecystectomy is still the gold standard for treating cholelithiasis, but for individuals with symptomatic cholelithiasis who do not have acute cholecystitis, laparoscopic cholecystectomy is advised.⁷

In addition, the management of choledocholithiasis is distinguished based on whether CBD is difficult or not. The size of the stone and the papilla of Vater must also be considered throughout the stone extraction process.

The success rate of endoscopic retrograde cholangiopancreatography (ERCP) for treating bile duct stones smaller than 1.5 cm is around 100%. Additionally, the best course of treatment for difficult cases with CBD stones is endoscopic sphincterotomy plus endoscopic papillary balloon dilatation (EPBD). However, if large endoscopic sphincterotomy is performed, there are additional risks such as bleeding and perforation.

There are two cholangioscopy methods that can be performed in cases of CBD stones, electrohydraulic

lithotripsy (EHL) and laser lithotripsy. The effectiveness of stone clearance in this method can reach 97-100% in multiple sessions. While the complication rate in cholangioscopy ranges from 0-25% in the form of cholangitis.⁸

CHOLANGIOSCOPY

Types of Cholangioscopy

1. Percutaneous Cholangioscopy

Also known as percutaneous transhepatic cholangioscopy, this technique is primarily used in cases where peroral cholangioscopy (POC) is not feasible or effective. It is particularly beneficial for patients with altered gastrointestinal anatomy, such as those who have undergone Billroth II or Roux-en-Y procedures, as well as individuals with intrahepatic or large gallstones exceeding 1.5 cm in size. The use of a short cholangioscope, usually a ureteroscope, is a major benefit of this technique as it improves maneuverability and access to difficult-to-reach places that may be problematic to reach with POC. Furthermore, it is easy to undertake several follow-up procedures once a percutaneous tract has been established. However, its main disadvantages are the procedure's invasiveness and the length of time needed for the tract to mature, which makes it a backup option in cases where POC is not practical.

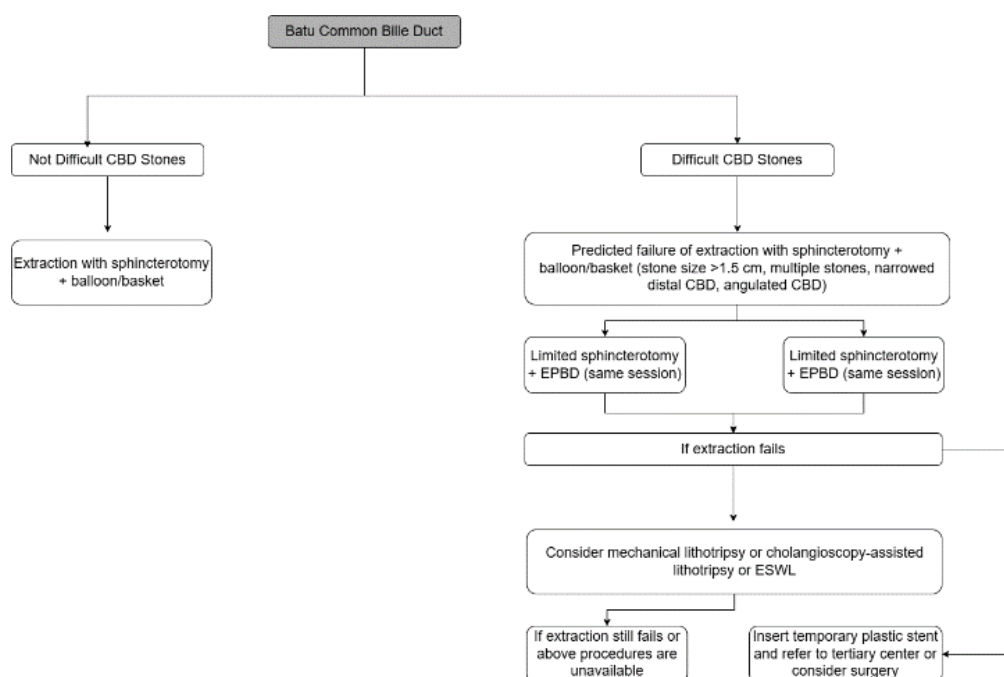


Figure 1. CBD Stone Management Algorithm

2. **Dual operator POC for mother and infant**
Dual operator cholangioscopy and mother-child. POC is one of the techniques that has undergone significant development in the field of biliary endoscopy. Two operators are involved in this technique; one operates the mother, the main instrument, while the other operates the baby, a smaller instrument utilized for further bile duct imaging and manipulation. This method's benefit is that it can improve access and boost efficacy in diagnosing and treating complicated illnesses including tough gallstones and unexplained biliary strictures. Although this technique offers many benefits, challenges such as the need for high operator skills and relatively high costs remain a concern. With technological advances and improvements in image quality as well as the development of accessories, it is hoped that mother-baby cholangioscopy can be more widely adopted in clinical practice to improve the outcomes of patients with biliary tract diseases. Involves two endoscopists: one managing the duodenoscope ("mother") and the other the cholangioscope ("baby"). It provides enhanced access for treating complex stones and strictures. Despite its benefits, high costs and operator dependency limit widespread adoption.⁹
3. **Single operator POC**
Single-operator per-oral cholangioscopy (POC) has undergone significant advancements in biliary endoscopy, enabling direct visualization and therapeutic intervention within the biliary system. This method, called SpyGlass™, provides better access to complex illness diagnosis and treatment., such as unexplained biliary strictures and intractable gallstones. Although POC has shown high efficacy in clearing gallstones and improving diagnostic capabilities, challenges such as the need for high operator skill and the risk of complications remain. Studies have shown that POC can reduce the need for mechanical lithotripsy and increase the sensitivity of direct biopsy in detecting malignancies. Compared to regular ERCP, POC cholangioscopy had a greater rate of adverse events despite being generally safe. It is hoped that POC would be used more frequently in clinical practice to enhance the treatment outcomes for patients with biliary tract disease as a result of technological advancements and increases in picture quality.

4. **Direct POC (DPOC)**
One of the main advantages of Direct POC (DPOC), an endoscopic technique that uses an UltraSlim endoscope that is directly inserted into the biliary system during a routine upper endoscopy, is that it produces better images than other systems, and it also allows for electronic chromoscopy and a larger therapeutic channel. However, this technique also presents notable technical challenges, including difficulties in biliary cannulation and maintaining endoscope stability within the bile duct. Despite these challenges, DPOC proves to be valuable in diagnosing and managing unexplained biliary strictures, as it enables direct cholangioscopic biopsies, thereby enhancing diagnostic accuracy.¹⁰

Types of Cholangioscopy used for advanced CBD

Gallstones can be challenging to remove for a number of reasons, including the patient's clinical condition, the gallstones' features, and anatomical aspects. The patient's clinical conditions that influence this include age over 65 years, bleeding tendencies, and very poor medical conditions. Gallstones that are difficult to remove have characteristics of >1.5 cm in size, are box-shaped or barrel-like, have a hard consistency, and contain many stones (>3). Anatomical factors that influence this include narrowing of the distal bile duct, sigmoid-shaped common bile duct (CBD), and angulation >135 degrees at distal CBD, short distal CBD <36mm, periampullary diverticulum, and duodenal structure.⁹

When gallstones cannot be extracted after balloon dilation, but the dimensions of the gallstones still exceeds the width of the distal CBD, mechanical litholysis (LM) can be performed. The success rate of LM ranges from 79% to 96%, with a low mortality rate. Only 3.5% of adverse events, such as ductal perforation and instrument failure, occur after LM.. (16) Failure of extraction using LM is generally caused by gallstone impaction in the CBD and stone size exceeding 3 cm.¹¹

In these situations, gallstones can be broken up under direct vision using intraluminal lithotripsy aided by cholangioscopy, such as electrohydraulic lithotripsy (EHL) or laser lithotripsy (LL). Three cholangioscopy techniques are available: the direct technique, which makes use of the currently available ultrathin gastroscope; the single-operator technique (Spyglass, manufactured by Boston Scientific, situated in Natick, MA, United States); and the dual-operator technique, which is the oldest.⁹ When compared to

spyglass cholangioscopy, direct cholangioscopy using a standard gastroscope provides superior stability and visibility, as well as strong irrigation and aspiration capabilities that enable high-quality electrohydraulic lithotripsy and the removal of large debris. However, this technique should only be used for stones larger than 2 cm and dilated bile ducts with a diameter of more than 1.5 cm, according to Brian et al.¹²

While EHL was linked to a higher incidence of post-procedural complications, including cholangitis, hemobilia, and pancreatitis (13.8%), while LL had a lower rate (9.6%), LL showed a significantly higher total bile duct clearance rate (95.1%) than EHL (88.4%) in the study by Veld et al. Despite these findings, a meta-analysis by Galetti et al. found that EHL was superior compared to LL, with an average of 88.6% for LL and 91.4% for EHL for successful endoscopic clearance.¹³ This is because, in contrast to Veld et al., the inclusion selection was more selective.¹⁴

When ERCP and Cholangioscopy are used

A medical treatment called endoscopic retrograde cholangiopancreatography, or ERCP, is used to identify and treat issues with the pancreas, liver, and bile ducts. Initially, ERCP was used more often for diagnostic purposes, but as the technique has improved, it is now used more for therapy. For example, ERCP can be used to treat gallstones that block the ducts, treat narrowing of the ducts due to tumors or other conditions, and repair leaks in the bile ducts and pancreas. ERCP uses endoscopic technology to see directly into the digestive tract and perform treatment. As technology advances, ERCP continues to improve. One example is the use of disposable duodenoscopes, which assist reduce the risk of infection in hospitals. Additionally, the use of ERCP in conjunction with other procedures like laparoscopy and endoscopic ultrasound (EUS) has improved physicians' capacity to identify and address issues in the pancreatic and hepatobiliary systems. This allows for more targeted treatment and reduces the need for more invasive open surgical procedures.¹⁵

When direct bile duct vision is necessary particularly when traditional imaging, such ERCP, cannot yield a conclusive diagnosis cholangioscopy is employed. When biliary strictures cannot be identified as benign or malignant, this method is very helpful, especially when determining the patient's illness type. Cholangioscopy is also indicated in the treatment of gallstones that are difficult to remove, especially when the stone is stuck in the bile duct and conventional methods fail to remove it. This procedure provides direct and detailed

visualization, which is very helpful in determining the right treatment steps.¹⁶

With the latest technology such as the SpyGlass DS system, the resulting image quality is much better, making it easier for doctors to perform minimally invasive procedures. In addition, cholangioscopy can be used to perform lithotripsy as well as removing foreign objects that are stuck. This procedure is also often used to monitor conditions such as primary sclerosing cholangitis and Mirizzi syndrome, providing great benefits in the management of complex and chronic biliary tract disease.⁵

Role of Cholangioscopy in Choledocholithiasis

Choledocholithiasis can be treated with surgery, endoscopy, and lithotripsy with the aim of cleaning the common bile duct.¹¹ Treatment with drugs such as ursodeoxycholic acid is not recommended for treating and preventing gallstones.³ Choledocholithiasis also has indications for cholecystectomy, because in most cases it is caused by migration of gallstones in the gallbladder. Cholangioscopy plays a role in endoscopic therapy and lithotripsy. In the endoscopic process using the ERC (endoscopic retrograde cholangiography) method, cholangioscopy increases the accuracy of detecting residual stones by 23% of negative cases.¹¹

In cases of pregnancy, cholangioscopy can minimize the effects of radiation.³ Because it is challenging to remove stones using the ERC method in patients with stone sizes greater than 1.5 cm and narrowing of the common bile duct, lithotripsy may be utilized. Cholangioscopy plays a role in lithotripsy as direct visual control. The use of cholangioscopy with a single operator such as SpyGlass allows the lithotripsy process to be safer.¹¹ The efficacy of lithotripsy with cholangioscopy assistance has a success rate of clearing gallstones of 88%.¹⁷ **(Table 1)**

Table 1 Advantages and Disadvantages of Each Type of Cholangioscopy

Type of Cholangioscopy	Advantages	Disadvantages
Percutaneous Cholangioscopy	<ul style="list-style-type: none"> Effective for patients with altered GI anatomy (e.g., Roux-en-Y, Billroth II) Allows repeated access once percutaneous tract is matured 	<ul style="list-style-type: none"> More invasive procedure Requires time for tract maturation Higher risk of infection
Dual-Operator Cholangioscopy (Mother-Baby)	<ul style="list-style-type: none"> Enhanced visualization and maneuverability Useful in complex strictures and large stones 	<ul style="list-style-type: none"> Requires two skilled operators High equipment cost Limited availability
Single-Operator Cholangioscopy (e.g., SpyGlass™)	<ul style="list-style-type: none"> Performed by a single endoscopist Real-time direct visualization and targeted biopsy Widely adopted in clinical settings 	<ul style="list-style-type: none"> Requires specialized training High device and accessory cost May be challenging in very narrow bile ducts
Direct Peroral Cholangioscopy (DPOC)	<ul style="list-style-type: none"> High-resolution imaging Larger therapeutic channel Supports advanced techniques like electronic chromoendoscopy 	<ul style="list-style-type: none"> Technically demanding Difficult cannulation and scope stabilization Requires high operator expertise and experience

Comparative Effectiveness: Cholangioscopy vs. Conventional ERCP

The use of cholangioscopy has emerged as an advanced diagnostic and therapeutic modality in the management of complex choledocholithiasis, particularly in patients with difficult bile duct stones (DBDS). Compared to endoscopic retrograde cholangiopancreatography (ERCP) the current standard for bile duct interventions cholangioscopy offers enhanced visualization, targeted stone therapy, and improved diagnostic precision in biliary strictures. However, these benefits must be weighed against increased procedural time, limited availability, and higher costs. The following table summarizes critical parameters comparing cholangioscopy with conventional ERCP based on recent systematic reviews and clinical studies (Table 2).

Multiple studies have highlighted the superior diagnostic yield of cholangioscopy in differentiating indeterminate biliary strictures and managing large or impacted bile duct stones. Galetti et al. (2020) found a pooled stone clearance success rate of 88.3% in

DBDS patients undergoing cholangioscopy-guided interventions, which remains high even in multi-session treatments.¹³ In contrast, conventional ERCP, though still highly effective in general choledocholithiasis, often fails in patients with complex anatomical factors or prior surgical alterations.

Furthermore, cholangioscopy provides real-time intraductal visualization, enabling endoscopists to perform precise biopsies and laser lithotripsy under direct vision capabilities not possible with ERCP alone.¹⁰ These strengths make it an invaluable tool for complex cases such as Mirizzi syndrome or intraductal neoplasms.

However, procedural duration is significantly longer, averaging nearly 28 minutes more than standard ERCP, and requires operators with advanced technical skills. The cost of SpyGlass systems and related accessories also limits widespread adoption, particularly in developing healthcare systems.⁵

In conclusion, while cholangioscopy presents superior efficacy in complex and diagnostically challenging cases, ERCP remains the first-line

Table 2. Comparative Effectiveness of Cholangioscopy vs. ERCP in Complex Biliary Stone Management

Aspect of Evaluation	Cholangioscopy	Conventional ERCP	Source
Stone Clearance Rate	88.3% (CI: 83.2%–91.8%) overall success in DBDS	85–95% for routine CBD stones, lower for DBDS	Galetti et al., 2020; Korrapati et al., 2016
Single-session Success	72.7% success in clearing stones in one session	>85% for standard cases; ~60% for DBDS	Galetti et al., 2020
Procedure Duration	Longer; mean added time of +27.89 minutes	Shorter average duration	Galetti et al., 2020
Complication Rate	8.7% (CI: 7%–10.9%) overall; includes cholangitis, hemobilia, mild pancreatitis	7–10%, commonly pancreatitis or bleeding	Galetti et al., 2020; Korrapati et al., 2016
Diagnostic Capability	Direct visualization; allows real-time biopsy and lithotripsy	Fluoroscopy-based; indirect, no biopsy visualization	Galetti et al., 2020; Prat et al., 2012
Lithotripsy Utility	Highly effective for large, impacted stones using EHL or LL under direct vision	Limited; often requires multiple sessions or mechanical lithotripsy	Prat et al., 2012; Ayoub et al., 2018
Use in Indeterminate Biliary Strictures	High diagnostic yield; targeted biopsies improve accuracy	Low sensitivity; sampling often blind	Korrapati et al., 2016; Ayoub et al., 2018
Technological Requirement	Requires digital cholangioscopes (e.g., SpyGlass DS), special training	Widely practiced; no additional visual tools needed	Ayoub et al., 2018; Galetti et al., 2020
Cost and Availability	Expensive equipment; limited access in low-resource settings	Lower cost, widely available worldwide	Galetti et al., 2020; Stassen et al., 2021

modality due to its accessibility, cost-effectiveness, and robust efficacy in typical cases. Judicious case selection is necessary to optimize outcomes and resources.

Clinical Utility of ERCP and Cholangioscopy: Indications, Contraindications, Advantages, and Limitations

In the management of biliary tract diseases, Endoscopic Retrograde Cholangiopancreatography (ERCP) and cholangioscopy serve as cornerstone modalities, each with specific clinical indications, technical characteristics, and limitations. ERCP remains the first-line technique for the diagnosis and treatment of common bile duct (CBD) stones, biliary leaks, strictures, and pancreatic duct disorders. It is widely available, relatively cost-effective, and has demonstrated a high success rate for routine stone clearance, ranging between 85% and 95%.¹³ However, for complex cases such as large or impacted stones, strictures of unclear etiology, or failed ERCP attempts, cholangioscopy has proven to be a superior adjunct or alternative approach.

Cholangioscopy, particularly with the advancement of single-operator digital systems such as SpyGlass DS™, enables direct intraductal visualization of the biliary tree. This real-time access allows clinicians to perform targeted biopsies and guide intraductal therapies such as electrohydraulic lithotripsy (EHL) or laser lithotripsy (LL) with greater precision. In a meta-analysis by Galetti et al. (2020), the overall success rate of cholangioscopy-guided lithotripsy for difficult bile duct stones was reported at 88.3%, with a first-session success rate of 72.7%.¹³ Although the therapeutic success was comparable to ERCP, cholangioscopy required significantly longer procedural time, approximately 27.89 minutes more on average.¹⁷ Moreover, complication rates between the two methods were similar, with cholangioscopy showing an adverse event rate of 8.7%, including mild cases of cholangitis and hemobilia.¹³

Indications for ERCP include routine stone clearance, stenting of benign or malignant strictures, biliary leaks, and post-surgical evaluations. Contraindications include acute pancreatitis, allergy to contrast media, and uncontrolled coagulopathy. Cholangioscopy is best indicated for patients with difficult bile duct stones, indeterminate strictures, or prior failed ERCP, and is contraindicated in patients with unstable vitals, severe infection, or without proper equipment availability. **Table 3** summarizes the key differences in clinical application, efficacy, diagnostic utility, and operational feasibility between ERCP and cholangioscopy.

Table 3 presents a side-by-side clinical comparison, emphasizing that while ERCP is ideal for standard procedures, cholangioscopy excels in diagnostic precision and therapeutic control, particularly in failed or complex ERCP cases.

Table 3. Clinical Comparison Between ERCP and Cholangioscopy

Aspect	ERCP	Cholangioscopy
Primary Indications	CBD stones, strictures, leaks, pancreaticobiliary disorders	Difficult CBD stones, indeterminate strictures, PSC, Mirizzi syndrome
Contraindications	Acute pancreatitis, allergy to contrast, uncorrected coagulopathy	Severe cholangitis, unstable hemodynamics, unavailable access route
Visualization	Indirect via fluoroscopy	Direct endoscopic visualization
Biopsy Capability	Blind brush cytology or biopsy	Targeted visual-guided biopsy
Stone Management	Basket or balloon extraction, mechanical lithotripsy	EHL or LL under direct view
Diagnostic Accuracy (Strictures)	Moderate (60–70%)	High (up to 93%)
Procedure Duration	Shorter	~27.89 minutes longer (Galetti et al., 2020)
Complication Rate	~7–10%	~8.7% (Galetti et al., 2020)
Availability	High – standard in most endoscopy units	Limited – requires SpyGlass or equivalent system
Cost	Lower	Higher

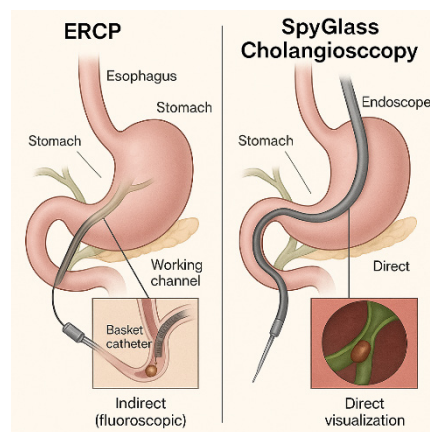


Figure 2. Procedural and Visual Differences Between ERCP and SpyGlass Cholangioscopy

Figure 2 illustrates anatomical and procedural distinctions. On the left, ERCP utilizes fluoroscopic guidance via a working channel to access and treat the biliary tract, often relying on indirect imaging. On the right, the SpyGlass cholangioscope allows direct visualization of intraductal structures and pathology, greatly enhancing biopsy targeting and therapeutic lithotripsy. This visualization difference underpins many of cholangioscopy’s clinical advantages,

especially in situations where diagnostic certainty or stone clearance is difficult to achieve with fluoroscopic techniques alone.

CONCLUSION

Cholangioscopy plays an important role in endoscopic therapy and lithotripsy. However, the availability of cholangioscopy equipment in Indonesia is still very rare so this procedure is not used as the main management in cases of choledocholithiasis but rather as a supporting procedure for ERCP. In the ERC method, cholangioscopy increases the accuracy of detecting residual stones by up to 23% in negative cases, and reduces the effects of radiation on pregnant patients. Because the ERC technique is less effective for patients with stones larger than 1.5 cm and constriction of the common bile duct, lithotripsy is required. Cholangioscopy assists in intraductal, electrohydraulic, and laser lithotripsy, by ensuring high accuracy so as not to damage the bile duct structure through visual control.

REFERENCES

- Hartanto P, Susanto H, Setiawan E. Prevalence of choledocholithiasis in Indonesia: a review. *Indones J Gastroenterol*. 2021;22(1):45–51. <https://doi.org/10.20473/ijg.2021.22.1.45>
- Pratama S, Lestari N, Nugroho S. The impact of metabolic syndrome on the prevalence of choledocholithiasis among the elderly in Indonesia. *J Clin Gastroenterol*. 2022;56(2):112–8. Available from: <https://www.jcgastro.org/article/view/choledocholithiasis-indonesia>
- Renaldi K, Firman FH. Current diagnosis and treatment of choledocholithiasis. *Indones J Gastroenterol Hepatol Dig Endosc*. 2024
- McNicoll CF, Pastorino A, Farooq U, et al. Koledokolitiasis. In: *StatPearls* [Internet]. Treasure Island (FL): StatPearls Publishing; 2024 Jan–. [updated 2023 Jul 10]. Available from: <https://www.ncbi.nlm.nih.gov/books/NBK441961/>
- Susilo J, Wibowo BT, Tinasari Y, et al. Case study: gallstones (cholelithiasis) in long-tailed macaques (*Macaca fascicularis*). *J Medika Veterinaria*. 2021;15(2).
- Amelia DN. Gambaran Pasien Koledokolitiasis di Bagian Bedah Digestif RSUP Dr. Hasan Sadikin Bandung Periode Januari 2016–Desember 2019.
- Adhata AR, Mustofa S, Soleha TU. Diagnosis dan tatalaksana kolelitiasis. 2022;12(Apr):75–8.
- Rivai MI, Lalisang A, Nugroho A, et al. Konsensus Perhimpunan Dokter Spesialis Bedah Digestif Indonesia tentang Pedoman Diagnosis dan Tatalaksana Batu Saluran Empedu. *J Indones Med Assoc*. 2024;74(2):51–63. <https://doi.org/10.47830/jinma-vol.74.2-2024.1188>
- Tringali A, Costa D, Fugazza A, et al. Endoscopic management of difficult common bile duct stones: where are we now? A comprehensive review. *World J Gastroenterol*. 2021;27(44):7597–611. <https://doi.org/10.3748/wjg.v27.i44.7597>
- Ayoub F, Yang D, Draganov PV. Cholangioscopy in the digital era. *Transl Gastroenterol Hepatol*. 2018;1–10. <https://doi.org/10.21037/tgh.2018.10.08>
- Costi R. Diagnosis and management of choledocholithiasis in the golden age of imaging, endoscopy and laparoscopy. *World J Gastroenterol*. 2014;20(37):13382. <https://doi.org/10.3748/wjg.v20.i37.13382>
- Fung BM, Pitea TC. Removal of giant choledocholithiasis by direct cholangioscopy with gastroscope and electrohydraulic lithotripsy. *Clin Gastroenterol Hepatol*. 2023;21(3):A15–6. <https://doi.org/10.1016/j.cgh.2022.07.026>
- Galetti F, Moura DTH, Ribeiro IB, et al. Cholangioscopy-guided lithotripsy vs conventional therapy for complex bile duct stones: a systematic review and meta-analysis. *Arq Bras Cir Dig*. 2020;33(1):e1491. <https://doi.org/10.1590/0102-672020190001e1491>
- Veld JV, van Huijgevoort NCM, Boermeester MA, et al. A systematic review of advanced endoscopy-assisted lithotripsy for retained biliary tract stones: laser, electrohydraulic or extracorporeal shock wave. *Endoscopy*. 2018;50(9):896–909. <https://doi.org/10.1055/a-0637-8806>
- Sanders DJ, Bomman S, Krishnamoorthi R, Kozarek RA. Endoscopic retrograde cholangiopancreatography: current practice and future research. *World J Gastrointest Endosc*. 2021;13(8):260.
- Mauro A, Mazza S, Scalvini D, et al. The role of cholangioscopy in biliary diseases. *Diagnostics*. 2023;13(18):2933.
- Korrapati P, Ciolino J, Wani S, et al. The efficacy of peroral cholangioscopy for difficult bile duct stones and indeterminate strictures: a systematic review and meta-analysis. *Endosc Int Open*. 2016;4:E263–75.