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The Role of Cholangioscopy in Choledocholithiasis Cases

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ABSTRACT

The condition known as choledocholithiasis, which is caused by the presence of stones that obstruct the bile duct, can be divided into two categories: primary choledocholithiasis, which is caused by obstructed bile flow that results in the formation of stones, and secondary choledocholithiasis, which is caused by cholelithiasis that has previously formed and is rejected into the common bile duct, causing blockage. The role of cholangioscopy in cases of choledocholithiasis will be discussed in this article. The study's findings indicated that cholangioscopy is crucial for endoscopic therapy and lithotripsy, but it is still very uncommon to find cholangioscopy equipment in Indonesia, so it is used as a supporting procedure for ERCP rather than as the primary management for choledocholithiasis.

Keywords :cholangioscopy, choledocholithiasis, diagnosis, therapy

ABSTRAK

Koledokolitiasis adalah kondisi dimana terjadinya penyumbatan pada saluran empedu karena adanya batu yang menyumbat. Koledokolitiasis dapat diklasifikasikan menjadi primer dan sekunder. Koledokolitiasis primer terjadi akibat aliran empedu yang terhambat sehingga terjadi pembentukan batu. Sedangkan koledokolitiasis sekunder terjadi akibat kolelitiasis yang telah terbentuk terlebih dahulu dan terejeksi ke duktus biliaris komunis dan menyebabkan penyumbatan. Koledokolitiasis dapat menyebabkan berbagai komplikasi yang memerlukan tatalaksana yang berbeda. Artikel ini akan membahas mengenai peran kolangioskopi pada kasus koledokolitiasis. Hasil studi menunjukkan bahwa Kolangioskopi berperan penting dalam terapi endoskopi dan litotripsi. Namun, kesediaan alat kolangioskopi di Indonesia masih sangat jarang sehingga prosedur ini tidak dijadikan tatalaksana utama pada kasus koledokolitiasis melainkan menjadi prosedur dukungan dari ERCP.

Kata kunci : 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. 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.

Choledocholithiasis can result in severe side effects that need to be treated right once, such as biliary blockage, 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 stone extraction in real time.

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

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. Studies show that at least 3%–10% of patients who have a cholecystectomy will develop stones in the common bile duct (CBD), and choledocholithiasis affects roughly 10%–20% of those with gallbladder stones. There are two types of choledocholithiasis: primary and secondary. Stones form as a result of blocked bile flow, which causes primary choledocholithiasis. However, cholelithiasis that has already developed and been rejected into the common bile duct, resulting in obstruction, causes secondary choledocholithiasis. (Renaldi and Firman, 2024).

Etiology and Clinical Manifestations

Gallstones can develop directly in the common bile duct (CBD) or migrate from the gallbladder to the bile duct in choledocholithiasis, a disorder related to gallstones. Several factors that can cause gallstones to form in the CBD include bile stasis (a condition in which bile does not flow smoothly), bile infection, chemical imbalance in bile, increased excretion of bilirubin, and pH imbalance. In rare cases, gallstones can also form in the small bile ducts in the liver (called primary hepatolithiasis) and then move to the CBD causing choledocholithiasis (McNicol et al., 2023).

Gallstones have various chemical compositions, including cholesterol stones and pigment stones. Cholesterol stones, which are composed of cholesterol, are the most common type of stone and make up about 75% of secondary gallstones in the CBD in the United States. Additionally, there are brown pigment stones, which are a combination of bile pigments and lipids, and black pigment stones, which are primarily made of bilirubin pigment. These brown pigment stones are typically discovered as primary gallstones that form directly within the central business district. (McNicol et al., 2023).

There are several causes of gallstones in the bile duct. One of them is cholesterol supersaturation, a condition in which cholesterol levels in bile exceed normal limits, causing the formation of cholesterol crystals that eventually form gallstones. Another factor is the production of too much bilirubin, which can crystallize and form pigment stones, which are typically made of calcium bilirubin. Additionally, the gallbladder's hypomotility or impaired contractility can cause bile to stagnate or flow improperly, which can result in gallstones. (Susilo et al., 2023).

Symptoms of choledocholithiasis include severe pain in the upper abdomen, jaundice that can occur if there is a blockage for a long time, fever, vomiting. Gallstones typically don't create any symptoms. Biliary colic is typically caused by choledocholithiasis blocking the bile duct, if symptoms appear. The upper right abdomen will be quite painful in this condition, and the discomfort may radiate to the shoulder, shoulder blade, and chest. Usually, nausea and vomiting accompany the pain. (Amelia, 2019).

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. (Adhata et al., 2022).

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.

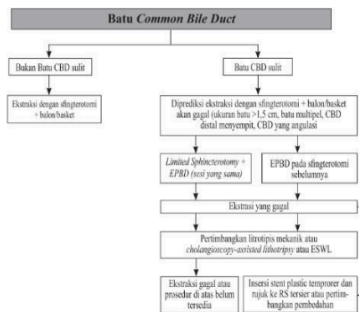


Figure 1. CBD stone management algorithm

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 (Rivai et al., 2024).

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.

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..

1. Single operator POC

2. 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 SpyGlassTM, 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.

3. Direct POC (DPOC)

4. 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 (Ayoub et al., 2018).

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, perampullary diverticulum, and duodenal structure (Tringali, A. et. al., 2021).

When gallstones cannot be extracted after balloon dilation, but the dimensions of the gallstones still exceeds the width of the distal CBD, mechanical lithotripsy (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. (Tringali, A. et. al., 2021). Failure of extraction using LM is generally caused by gallstone impaction in the CBD and stone size exceeding 3 cm (Costi R., 2014).

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. (Tringali A., et. al, 2015). 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. (Fung, B. M et. al., 2023).

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. This is because, in contrast to Veld et al., the inclusion selection was more selective. (Galetti F et. al., 2020).

When ERCP and Kolangioscopy 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 (Sanders et al., 2021).

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 (Mauro et al., 2023).

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, kolangioscopy 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 (Stassen et al., 2021).

Role of Cholangioscopy in Choledocholithiasis

Choledocholithiasis can be treated with surgery, endoscopy, and lithotripsy with the aim of cleaning the common bile duct (Costi, 2014). Treatment with drugs such as ursodeoxycholic acid is not recommended for treating and preventing gallstones (Renaldi, K. and Fauzan HF, 2023). 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 (Costi, 2014).

In cases of pregnancy, cholangioscopy can minimize the effects of radiation (Renaldi, K. and Fauzan HF, 2023). 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 (Costi, 2014). The efficacy of lithotripsy with cholangioscopy assistance has a success rate of clearing gallstones of 88% (Korrapati et. al., 2016).

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.

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