

Multimodality Treatment of Bile Duct Stone

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ABSTRACT

Gallstone and bile duct stone is a common disease and affects people from every society, race, age and gender. Advance in medicine has led us to a new paradigm of bile duct stone treatment. Endoscopic procedures for bile duct stone by means of Endoscopy Retrograde Cholangio-pancreatography (ERCP), sphincterotomy, balloon dilation, basket extraction, and lithotripsy, and even using laser as well as the shockwave-has brought a lot of novel innovation with high success rate.

Appropriate indication and the ability to recognize various risk factors of complication are the keys to successful treatment, in order to decrease morbidity and mortality rate. Multimodality treatment of bile duct stone includes endoscopy, surgery, and drugs are a treatment approach which has always to be carried out in bile duct stone management. Difficult bile duct stone cases such as large stone, impacted stone, biliary stone in pregnancy, and recurrent stone can be treated by endoscopy with excellent success rate particularly if it is accomplished using multimodality treatment.

Keywords: *bile duct stone, endoscopy, ERCP, sphincterotomy, mechanical lithotripsy, laser lithotripsy, shockwave, cholecystectomy laparoscopy, precut sphincterotomy*

INTRODUCTION

Medical technology has advanced rapidly as well as the technology progression, which has brought us to a new paradigm in diagnosis and treatment of diseases. One of those are stone in gallbladder (cholelithiasis) and biliary duct stones (choledocholithiasis). Most bile duct stones are gallstones that have passed the bile duct. Endoscopic Retrograde Cholangio-pancreatography (ERCP) is a breakthrough in medical advance which start to be employed frequently in diagnosing and managing bile duct stones.

EPIDEMIOLOGY

Gallstone affects people from various societies, races, genders, and age. It is estimated that

approximately 15% USA populations have gallstone. The epidemiology of gallstone is influenced by biological and lifestyle factors. Biological factors are race, gender, age, underlying disease, and the triglycerides serum level. The incidence on female is 2-4 times greater than in male, hormone is believed to be the reason. Gallstone is also frequently found in pregnancy. Lifestyle factors include physical inactivity, obesity, and rapid weight loss. Biliary stone disease in Indonesia has just started to have clinical attention whilst research publication on biliary stone is still limited.¹⁻⁵

DEFINITION

Cholelithiasis or gallstone is stone in gallbladder whilst choledocholithiasis is stone in bile ducts. Choledocholithiasis or bile duct stone can be classified into primary stone, which is formed in bile ducts; and secondary stone, which descends from gallbladder through bile ducts. Choledocholithiasis can be

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categorized according to its location, i.e. intrahepatic and extrahepatic. Sludge is suspension of cholesterol monohydrate crystal, calcium bilirubinate granules, and/or other calcium salts with or without microlithiasis in the gall bladder mucus. It is a type of gall bladder disease and is a predisposition of macroscopic stone or it can directly causes off pancreatitis or other morbidities.¹

BILE DUCT STONE TREATMENT

Endoscopy

ERCP is an endoscopic procedure for bile duct stone treatment. Through ERCP we can observe the ampulla of Vater condition and in conjunction with radiography, it can generate high quality imaging results, thus it can become examination tool for diagnostic and also therapeutic measures of pancreatobiliar system. Patient preparation is the same with upper gastrointestinal tract endoscopy and it is best that the patient is under narcotic condition.⁶

Therapeutic ERCP with sphincterotomy to extract bile duct stone without surgery was accomplished for the first time in 1974. The impressive success of sphincterotomy and strong will from the patients has impelled numerous gastrointestinal endoscopic centers to broaden the indication of sphincterotomy even to patients with intact gallbladder who develop Common Bile Duct (CBD) stone clinical problems. In Indonesia, especially in Jakarta, sphincterotomy has been performed since 1983. However, such development has not reached all of gastrointestinal endoscopic centers because therapeutic ERCP requires special skills, adequate number of patients, and also acceptable fluoroscopy equipment in order to obtain fine photographic results. A study conducted in Jakarta in 1991, by Lesmana et al demonstrated that the success rate of non-surgical CBD stone extraction technique is 85% (123 of 142 patients) with complication rate of 10%.^{2,7}

Sphincterotomy

Sphincterotomy is a method for performing inner-layer incision of Oddi sphincter muscle by using a cauter. The purpose of this measure is to release anatomical obstruction in biliary sphincter, thus facilitating the stone's movement during extraction. The common complication of sphincterotomy is pancreatitis although actually this complication is actually more often correlated to ERCP procedure (even without sphincterotomy).^{8,9}

Short term complication is directly associated with endoscopic procedure and sphincterotomy (immediately found or within 30 days following the procedure) with incidence rate of 5.8-9.8%, and two third of them are minor complication. The most

frequent complication is pancreatitis, followed by bleeding.

Several bleeding risk factors are history of hemodialysis, prolonged prothrombin time, bleeding during procedure, impacted stone in papilla, periampullary diverticulum, and augmentation of previous sphincterotomy. Most complications are minor bleeding, which can be managed by epinephrine irrigation and also epinephrine injection with 1 : 10,000 concentrations. Long term complications on sphincterotomy are reoccurrence bile duct stone, papillary stenosis, chronic pancreatitis and cholangitis (infection). Incidence of these complications vary from 6.8-24% with reoccurrence of bile duct stone as the most frequent long term complication.^{9,11}

Endoscopic Balloon Dilation

Bile duct stone treatment with endoscopic procedure is not only by means of sphincterotomy, it can also use balloon. Differences with sphincterotomy, balloon is employed to dilate the sphincter of Oddi. In actual practice however, both procedures can be employed concomitantly. The advantage of balloon dilation technique is it can maintain normal function of biliary sphincter. The papillary function can be loss on sphincterotomy, thus bacterial colonization on bile ducts originating from gastrointestinal tract and chronic inflammation on bile ducts mucosa may occur. Bleeding risk is also smaller compared to sphincterotomy (moreover, it can be stated that there is no bleeding risk), thus, it can be used on patients with high risk of bleeding such as patients with hemodialysis or liver cirrhosis.^{12,13}

Pancreatitis is a complication which is often associated with balloon dilation procedure. Numerous studies have reviewed the incidence of pancreatitis following balloon dilation. A study in United States demonstrated that pancreatitis complication rate in the balloon dilation group was significantly higher compared to the sphincterotomy group (15.4% compared to 0.8%). However, several other studies offered different result. A study in Netherland indicated that the pancreatitis rate was not significantly different among both procedures (5-7%). A study in Japan showed the success rate of balloon dilation technique of 99% and without occurrence of serious complication. Another study in Netherland (blinded and randomized) found that the complication rate was not significantly different for each therapeutic procedure. Based on the above-mentioned data, apparently there is still a debate between sphincterotomy and balloon dilation procedures. Currently, sphincterotomy is the standard procedure in CBD stone treatment. Nowadays, it is agreed that the indications for balloon dilation include patients with severe coagulation disorders and altered anatomical structure (for example

due to surgical procedure); therefore, performing sphincterotomy will be more difficult and risky.^{14,16}

CBD Extraction

CBD stone extraction usually performed with basket extraction or balloon catheter. The type of basket that usually used are Dormia-type basket, particularly if there is massive ducts dilation. Basket can also function as a lithotriper to reduce stone size before finally extracted. Balloon catheter for stone extraction is available in several balloon diameter; ranging from 8-18 mm and it is especially useful to clear multiple small stones, sludge, and microlithiasis. There are several advantages of using the balloon such as it can be inflated with variety amount of air so variety balloon size can be obtained (though optimal balloon size is obtained when the balloon is fully inflated); it can also assess the sufficiency of sphincterotomy before stone extraction is performed; and the absence of impaction risk (compared to basket utilization). It has disadvantage such as it cannot be used effectively on massive dilated ducts because the balloon may be wedged between the stone and duct's wall and the balloon could burst if it contacts with sharp stone's edge.¹⁷

Lithotripsy

Mechanical lithotripsy is a technique used for destroying large stone that cannot be extracted by means of simple sphincterotomy. In compilation of three series mechanical lithotripsy studies, the success rate of bile ducts clearance is 86% with 7% morbidity. The success rate of mechanical lithotripsy is 90% for stones sized 10 mm or less and is 68% for stones sized over 28 mm.^{1,18,19}

Intracorporeal lithotripsy can be performed by means of Electrohydraulic Lithotripsy (EHL) or laser lithotripsy. EHL causes shockwave which vaporizes the surrounding fluid and transmits such energy through small probe (3 Fr/1 mm) and is directed right at the stone. In five series of studies, with 185 CBD stone patients which cannot be extracted using the regular procedure, EHL success rate is 85% with minimal morbidity. Reported morbidity rate ranges around 9% and mostly minor.^{1,20}

There are three laser lithotripsy endoscopic systems for treating CBD stone, which are: Q-switched neodymiumyttrium-aluminium-garnet (Nd YAG); flash lamp pulsed dye; and flash lamp pulsed dye with automatic stone recognition system. Pigment in the stone will absorb laser beam (which is produced by the system) on specific wave length; thus limiting its distribution as merely inside the stone. Spectrometry using flash lamp pulsed dye is able to recognize the stone automatically; thus the precision of procedure can be improved.^{1,21}

According to study series of recurrent biliary stone, the bile duct stones of 92% patients can be cleared by the laser system although usually, for the cases of very large stone and multiple stones, 2-3 treatment sessions are needed. The morbidity rate is reported as approximately 7% and generally minor (transient hemobilia, cholangitis, and pancreatitis). Holmium YAG laser is a small and portable unit laser which is frequently used in lithotripsy of urology cases. Although there has not been many reports on this system but its utilization for bile duct stone appears to be effective.^{1,22,23}

Extracorporeal shockwave lithotripsy (ESWL) focuses high-pressure shockwave energy on specific point of the body whilst minimizing the effect to the adjacent tissue. When shockwave energy hits the stone, the stone surface becomes porous and the alteration of acoustic impedance will produce compressive energy and pressure thus stone fragmentation takes place.

Shockwave energy is transmitted from above back part of the body for bile duct stone and from the area above the liver for intrahepatic stones (to avoid the presence of gas in gastrointestinal tract which interposes the stone). If fragmentation takes place, the fragments are cleared by regular procedure; however, if fragmentation has not taken place ESWL can be repeated in one week interval. Short term morbidity occurs on 14% of patients. The morbidities are pain, hemobilia, cholangitis, sepsis, hematoma, pancreatitis, hematuria, ileus and anaesthetical problems. Mortality occurs on less than 1% patients and usually occur in elderly, severe comorbidity and concomitant cholangitis.^{1,24}

Study shows that the success rate of CBD stone clearance with laser lithotripsy is greater than ESWL, which are 92% compared to 66%. However there is no difference between the success rate of ESWL and EHL (79% compared to 75%, respectively). Cross-checked treatment among several lithotripsy techniques will improve procedure success rate, ranges from 94% up to 100%.^{1,23}

Surgery

Cholecystectomy laparoscopy is a minimally invasive surgical technique using pneumoperitonium, endocamera system and special instruments through monitor screen, without directly seeing and touching the gall bladder. Cholecystectomy laparoscopy is the initial treatment prioritized especially for patients with cholelithiasis. Some advantages of this technique are less pain, small surgical scar (2-10 mm), shorter hospitalization duration, faster normal activity recovery, and cost effective compared to open surgery. The technique is first introduced in late 1980s, and on majority of cases, it has replaced the open

cholecystectomy surgical technique. Open cholecystectomy is still needed if cholecystectomy laparoscopy failed or not feasible.^{2,25}

In Indonesia, especially in Jakarta, cholecystectomy laparoscopy method have been commenced since 1991 and then followed by other centers. In four-year period (1991-1994), laparoscopy surgery had been performed on 2,687 patients in four Indonesian centers, with cholecystectomy laparoscopy as the most major indication (of total 2,201 cases). Conversion to conventional cholecystectomy was necessary 2.7-6.2% patients. The main cause was difficulty in recognizing anatomical structure. The success rate of laparoscopy procedure in clearing the stones reached 75-90% of all cases. Morbidity rate occurs in 10% cases and mortality rate occurs in 1% cases.^{2,25}

DRUG TREATMENT

Ursodeoxycholic acid lowers cholesterol saturation in bile and appears to disperse cholesterol from stone through chemico-physical mechanism. Ursodeoxycholic acid can also inhibit cholesterol crystal nucleation. In patients with appropriate criteria, who have normal function of gallbladder and having radiolucent stone with diameter less than 10 mm, complete dissolution can be achieved in 50% of patients within 2 months up to 2 years with 8-10 mg/kg/day ursodeoxycholic acid.²⁶

BILE DUCT STONE TREATMENT APPLICATION

The management of biliary stone varies in several countries. Treatment consideration consists of individual presentation of each patient, procedure risk, and the availability of facility and human resources for the selected treatment, such as ERCP, laparoscopy and ESWL. The absolute contraindication is similar to the contraindication of endoscopy and ERCP in general; such as bowel obstruction, viscus perforation, and patient disagreement. Relative contraindication consists of coagulation disorder, severe co-morbidities, anastomosis procedure for gastrointestinal tract, gastric outlet, and/or proximal duodenal stenosis.¹

PREPARATION OF ERCP PROCEDURE

Procedure preparation includes of exploring medical history for gastrointestinal tract surgery that might alter the anatomical structure of gastrointestinal tract (Billroth or Rous-en-Y anastomosis). History of consumption of drugs such as aspirin, anti-inflammatory drugs, platelet inhibitor or anticoagulant has to be identified. If there is coagulation disorder due to deficiency of vitamin-K-dependent blood

clotting factors, then vitamin K injection is administered. If there is primary fibrinolysis, tranexamid acid injection is administered. If there is deficiency of non-vitamin-K-dependent blood clotting factor, then the patient is given transfusion of deficient blood clotting factors or cryoprecipitate.^{1,27}

UNCOMMON CONDITION

Pregnancy

Approximately 8% of pregnant women have cholelithiasis and often symptomatic. Cholecystectomy can be delayed until labor; however, cholelithiasis potentially causes cholangitis or pancreatitis which usually needs immediate treatment. If ERCP is performed, potential risks for the fetus are sedative or analgesic effect, radiation exposure, and subsequent sequelae of procedure complication, such as hypoxia, pancreatitis, and sepsis. At least, there are 76 cases ERCP procedures in pregnancy from 36 references, 25 cases of them occur in the first trimester. Almost all patients finally gave birth to healthy a full term babies. Therapeutic success are regularly attained with minimal morbidity.^{1,28}

Impacted Stone

Impacted stone in ampulla can be treated with sphincterotomy, subsequent to placing a guidewire over stone position, and then stone extraction can be performed by regular procedure. If the abovementioned technique is not feasible to be performed, then "precut sphincterotomy" technique can be performed prior to the technique. When precut sphincterotomy with cauter, incision of protruding papillary tissue is performed parallel to the bile ducts. This technique requires experienced endoscopist with ability to control the apparatus in high precision. This technique is also associated with the increase of overall risk and complication stage compared to standard sphincterotomy.¹

CONCLUSION

CBD stone disease can be found around the world. Per-endoscopic CBD stone treatment using endoscopic cholangiopancreatography procedures in which consist of sphincterotomy techniques, balloon dilation, basket/balloon stone extraction, lithotripsy procedures, such as mechanical lithotripsy, shockwave (intracorporeal or extracorporeal), and laser are the latest advancement of CBD stone treatment. Using multimodality treatment, in conjunction with surgical and drug modality are expected to be able to treat difficult cases, such as cases with coagulation disorder, pregnancy, and difficult stones cases (large or impacted).

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