Introduction

ERCP with EST has been conventional treatment modality for the treatment of common bile duct (CBD) stone. By this conventional treatment modality, successful treatment of CBD stones are possible in 85-90% of patients. However, in 10-15% of patients, complete removal of CBD stones are impossible due to number, size and shape of stones, the degree of bending of distal CBD, bile duct stenosis, and anatomical alteration due to surgery etc. Generally, CBD stones which was recurred before 6 months after complete removal of stones are remnant CBD stones, and after 6 months are recurred CBD stones. The recurrence rate of CBD stones were reported about 3-15%. Risk factors of recurred CBD stones were gallbladder stones, mechanical lithotripsy, dilatation of CBD (more than 15mm in diameter), periampullary diverticulum, bending of CBD, stasis of bile juice, stenosis of bile duct, stenosis of ampulla, and hemolytic anemia.

In KPBA, recommended guideline for the difficult or recurrent CBD stones based on the America and Europe guidelines.

1. Management of difficult bile duct stones

1) Huge bile duct stones
   (1) Mechanical lithotripsy

   Recommended for the first line therapy for the huge CBD stones smaller than 3cm which was difficult to remove with conventional treatment modality (basket or balloon catheter after sphincterotomy) : evidence and recommendation 1B

   Mechanical lithotripsy is a very useful basic endoscopic skill, especially in case of huge CBD stone which cannot be removed by conventional method. The success rate of mechanical lithotripsy was 79-92%. Main causes of failure of mechanical lithotripsy are impaction of CBD stones in bile duct and the size of stones. If the diameter of the stones are larger than 3cm, it is difficult to grasp the stone with basket. Therefore, applied the me-
chanical lithotripsy in the diameter of stones are less than 3cm.\textsuperscript{11}

(2) Electrohydraulic lithotripsy (EHL) or laser lithotripsy (LL)

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<th>Treatment Modality</th>
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<tr>
<td>EHL or LL</td>
<td>Recommended for CBD stones which are difficult to remove with conventional methods. Evidence and recommendation 1B. EHL or LL are fragmentation of stone by contact the probe directly to the stones. Especially, EHL or LL are useful in impacted CBD stones. Usually, the success rate of EHL and LL were 74-95% and 88-97%, respectively.\textsuperscript{5, 12-19} For LL, FREDDY (Frequency Doubled Double Pulse YAG Laser) system or holmium laser systems were usually used. FREDDY system has advantage that it does not injure the human tissue.\textsuperscript{20} The complication rate of EHL or LL was 3-19%. The common complications are cholangitis and bleeding.\textsuperscript{12-14} Usually, mother-baby scope system had been used for EHL or LL. However, this system had disadvantages such as need two expert endoscopist and easily fragile baby scope system. Therefore, nowadays SpyGlass Direct Visualization System (Boston Scientific Corp. Natick, MA, USA) or direct peroral cholangioscope with ultra-slim endoscope can be used for EHL or LL.\textsuperscript{21-23} If fail to approach with ERCP, EHL or LL with percutaneous transhepatic choledochoscopy is a kind of alternative therapeutic modality.</td>
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(3) Endoscopic papillary large balloon dilatation (EPLBD)

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<td>EPLBD</td>
<td>Recommended in patients without distal CBD stricture in huge CBD stones which was difficult to remove with conventional method: evidence and recommendation 1B. In 2003, Ersoz et al. report about the usefulness of EPLBD after endoscopic sphincterotomy. EPLBD has been reported as an effective therapeutic modality for the difficult CBD stones.\textsuperscript{24-26} The successful complete removal rate of huge CBD stones with EPLBD has been reported 95-100% and the complication rate of EPLBD was 0-16%.\textsuperscript{24-26} EPLBD should be performed in patients without distal bile duct stricture to prevent the perforation. And limited EST was enough before EPLBD.</td>
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(4) Temporal endoscopic biliary stenting

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<tr>
<td>Temporal EST</td>
<td>Recommended in old age or high operation risk patients with huge CBD stones which was difficult to remove with conventional method. Temporal endoscopic biliary stenting increase secondary endoscopic success rate of removal of CBD stones: evidence and recommendation 2B. Although, temporal biliary stenting was not a established therapy for CBD stones, the procedure is relatively simple and easy, and through the stenting drain the infected bile and prevent the impaction of CBD stones. In some reports, the size of CBD stones decreased after biliary stenting because of friction between the stent and stones. Therefore, it makes easy to remove the CBD stones.\textsuperscript{27-29} Indications for temporal biliary stenting for CBD stones were huge CBD stones (diameter &gt;15mm), old age, and high surgical risk patients. The successful</td>
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stone complete CBD stone removal rate after temporal biliary stenting was 44-92%. Although there was no confirmation data about the duration of temporal biliary stenting, usually recommend 3 months to prevent stent induced ascending cholangitis.

1) Altered anatomy after surgery

Consult to the practiced expert or send to the upper grade hospital in patients with Billroth II or Roux-en-Y anastomosis.: evidence and recommendation rate 1C
If fail to successful removal of CBD stones in patients with Billroth II or Roux-en-Y anastomosis, percutaneous transhepatic choledochoscopic lithotripsy is useful treatment modality: evidence and recommendation 1B

For the successful CBD stone removal, selective cannulation of bile duct during ERCP is essential. However, after surgery such as Billroth-II or Roux-en-Y anastomosis, the successful selective cannulation rate was lower compare to normal. In such patients, there was difficulties in both approach to the ampulla and selective cannulation of bile duct because of altered anatomy. Especially, after Roux-en-Y anastomosis the selective cannulation rate were lower than Billroth-II anastomosis. And also the complication rate increased in patient with altered anatomy. Percutaneous transhepatic approach has disadvantages such as it takes long time and more invasive compare to ERCP. However, percutaneous approached could be applied in patients with failed ERCP.

2. Management of recurrent bile duct stones

1) Recurrent ERCP

Recurrent ERCP can be used as first line treatment modality for the recurrent CBD stones after ERCP.: evidence and recommendation 1C

The successful complete stone removal rate by ERCP is very high in recurrent CBD stones. ERCP for the recurrent CBD stones were usually safe because in these patient EST were performed previously. However, it is difficult to fix the causes of recurrent CBD stone, such as marked dilated bile duct (>15mm) or periampullary diverticulum. Geenen et al recommend surveillance ERC every year to prevent the recurrent cholangitis in patients with recurrent CBD stones. However, need more randomized controlled study to get the conformational result.

Conclusion

For the patients with huge CBD stones who fail to remove CBD stones with conventional ERCP, mechanical lithotripsy, laser lithotripsy, eletrohydraulic lithripsy, EPLBD, and temporal biliary stenting could be applied. Percutaneous transhepatic approach is a useful alternative treatment modality for the patients altered anatomy due to surgery. And ERCP is a very safe treatment modality for the patients with recurrent CBD stones.
References

40. Cariati A, Cetta F. Re: Kawai et al.--Bacteria are not important in the formation of pure cholesterol stones. Am J Gastroenterol 2002;97:2921-2; author reply 2922-2923.