Difficult Bile Duct Stone

SUSHIL AHLAWAT, MD, FACP, AFGA, FASGE
DIRECTOR OF ENDOSCOPY
RUTGERS NEW JERSEY MEDICAL SCHOOL

Disclosures

• I do not have any relevant financial relationships with any commercial interests.

Treatment of Bile Duct Stones

• Endoscopic papillotomy is the standard method of treating bile duct stones
• Approximately 85-90% of bile duct stones can be extracted using a retrieval balloon or basket after papillotomy
• Removal of bile duct stones may be difficult in 10-15% of patients

McHenry L and Lehman G. Current Treat Options Gastroenterol 2006;9:123.

What are “Difficult-to-treat” Bile Duct Stones?

• Anatomical situation
  – Altered anatomy, periampullary diverticulum
• Character of stones
  – Large, multiple stones
• Location of stones
  – Intrahepatic stones, stones above strictures, impacted stones (Mirizzi syndrome)
• Patient’s condition
  – Very poor general condition, elderly, coagulopathy, pregnancy
Difficult Bile Duct Stone

**Distal CBD Diameter & Stone Size**

- Sharma et al. WJG 2008;14:651.

- Distal CBD Diameter & Stone Size
  - A: 8mm, 4mm
  - B: 9mm, 8mm

**Distal CBD Length & Angulation**


- Distal CBD Length & Angulation
  - Length of distal CBD arm >36 mm
  - Distal CBD angulation >135 degrees
  - Length of distal CBD arm <36 mm
  - Distal CBD angulation <135 degrees
Endoscopic Techniques for Management of “Difficult-to-treat” Bile Duct Stones

• Endoscopic papillotomy (“Cut”)
• Endoscopic papillary balloon dilation (“Dilate”)
• Endoscopic papillotomy followed by large papillary balloon dilation (“Cut & dilate”)
• Mechanical lithotripsy
• Intra-ductal shock--wave lithotripsy

Endoscopic Papillotomy “Cut”

- Success rate of removing large stones by papillotomy alone is 12%.
- Technically difficult to perform in patients with altered anatomy, periampullary diverticula or small papilla.
- Complications (bleeding, perforation, pancreatitis, cholangitis) in 5-10 percent


Endoscopic Papillary Balloon Dilation “Dilate”

- Simple, easy to perform, lower risk of bleeding, cholangitis but higher risk of severe pancreatitis than papillotomy
- Efficacy similar or less than papillotomy
- Indicated for patients with altered anatomy, coagulopathy, duodenal diverticula

Weinberg BM, et al. CDSR 2006;18:CD004890
ASGE guideline 2012.

Papillotomy followed by Large Balloon Dilation “Cut” and “Dilate”

<table>
<thead>
<tr>
<th>Author (year)</th>
<th>No.</th>
<th>Indications</th>
<th>Success rate (%)</th>
<th>Use of EBL (%)</th>
<th>Complications rate (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sheet et al. (2003)**</td>
<td>58</td>
<td>With biliary strictures, tumors, beaded or hilar stones</td>
<td>88</td>
<td>7</td>
<td>16</td>
</tr>
<tr>
<td>Mayerio &amp; Brimhall (2003)**</td>
<td>60</td>
<td>Large stones</td>
<td>91</td>
<td>1</td>
<td>8</td>
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<tr>
<td>Saini et al. (2007)*</td>
<td>88</td>
<td>Large stones</td>
<td>95</td>
<td>1</td>
<td>17</td>
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<tr>
<td>Lee et al. (2007)*</td>
<td>200</td>
<td>-</td>
<td>97</td>
<td>8</td>
<td>5</td>
</tr>
<tr>
<td>Ananthakrishna et al. (2008)**</td>
<td>55</td>
<td>Large stone</td>
<td>100</td>
<td>5</td>
<td>4</td>
</tr>
<tr>
<td>Maro &amp; Drewitt (2009)**</td>
<td>107</td>
<td>Large stone</td>
<td>95</td>
<td>27</td>
<td>6</td>
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<tr>
<td>Kne et al. (2009)*</td>
<td>50</td>
<td>Large stone and/or with biliary stricture</td>
<td>100</td>
<td>10</td>
<td>14</td>
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<tr>
<td>Bok et al. (2009)**</td>
<td>27</td>
<td>Large stone</td>
<td>100 (average, 85)</td>
<td>33</td>
<td>0</td>
</tr>
<tr>
<td>Diffenbacher et al. (2009)**</td>
<td>44</td>
<td>-</td>
<td>95</td>
<td>16</td>
<td>7</td>
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<tr>
<td>Lee et al. (2009)*</td>
<td>53</td>
<td>Large stone</td>
<td>100</td>
<td>0</td>
<td>4</td>
</tr>
<tr>
<td>Lee et al. (2011)*</td>
<td>72</td>
<td>Large or multiple stones</td>
<td>97</td>
<td>8</td>
<td>8</td>
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<tr>
<td>Agathambad et al. (2011)*</td>
<td>45</td>
<td>Large stone</td>
<td>98</td>
<td>0</td>
<td>4</td>
</tr>
<tr>
<td>Rate et al. (2011)*</td>
<td>91</td>
<td>Large and/or multiple stones</td>
<td>95</td>
<td>11</td>
<td>0</td>
</tr>
<tr>
<td>Total</td>
<td>1053</td>
<td>10-20 mm</td>
<td>90.2</td>
<td>11.6</td>
<td>10.9</td>
</tr>
</tbody>
</table>

Pancreatitis (2.6%), bleeding (5.5%), perforation (0.2%), 2 deaths from severe bleeding & perforation
Difficult Bile Duct Stone

Papillotomy followed by Large Balloon Dilation “Cut” and “Dilate”

- Technique is not standardized
  - “limited or “maximum” papillotomy
    - Altered anatomy, periampullary diverticulum, small papilla
  - Duration of dilation: 10 s to 60 s; 2 min to 6 min
  - Size of balloon: 12 mm to 20 mm, proportionate to CBD and stone

- Avoid full-EST immediately before large balloon dilation
- Inflate the balloon gradually to recognize a narrowed distal CBD indicated by lack of disappearance of the balloon waist (occult stricture)
- Discontinue balloon inflation when resistance is encountered in the presence of persistent waist
- Do not inflate balloon beyond the maximal size of the upstream dilated CBD

Dig Dis Sci 2013;58:1100
Difficult Bile Duct Stone

Mechanical Lithotripsy

- Stones > 20 mm
- Inexpensive, readily available
- Success rate 79 to 92 percent
- Failure in impacted stone, very large stone
- Complications (bleeding, pancreatitis): 6-13 %
- Technical complications: impaction/wire fracture in 4 %

Difficult Bile Duct Stone

Intra-ductal Shock Wave Lithotripsy

- 2nd line method of stone therapy
- Shock wave may be generated in a fluid medium by a bipolar probe capable of generating a spark (electrohydraulic lithotripsy) or by pulsed dye laser systems (laser lithotripsy)
- Performed under direct cholangioscopy for accurate stone targeting and avoid injury to the bile duct wall
- BD stones above a stricture, impacted stones, failure of conventional techniques
- Limited availability

Intra-ductal Shock Wave Lithotripsy

- Mother-baby cholangioscope
  - High cost, requires 2 skilled endoscopists, difficult maneuverability, fragile
  - Stone clearance rate 90%, safe

- Ultra-slim cholangioscope
  - 2 mm channel
  - Direct insertion through the ampulla is technically difficult

Moon JH, et al. AJG 2009;104:2729
Arya N, et al. AJG 2004;99:2330

Intra-ductal Shock Wave Lithotripsy

- Single operator cholangioscope
  - 10F single use catheter-cholangioscope
  - 4 way maneuverability
  - separate irrigation and working channel
  - Single operator endoscope
  - Stone clearance 71-92%, Complication Rate 6.1%

Ahn et al. In ERCP 2nd Ed. 2013

Single Operator Cholangioscopy

<table>
<thead>
<tr>
<th>Study Type</th>
<th>Total Patient s</th>
<th>SOC-directed stone therapy</th>
<th>EHL</th>
<th>Stone clearance success rate</th>
<th>Complications</th>
</tr>
</thead>
<tbody>
<tr>
<td>Multi-center study (15 centers in US &amp; Europe)</td>
<td>297</td>
<td>66</td>
<td>50</td>
<td>76%</td>
<td>6.1%</td>
</tr>
<tr>
<td>US single center study</td>
<td>75</td>
<td>26</td>
<td>26</td>
<td>92%</td>
<td>4.8%</td>
</tr>
<tr>
<td>Rutgers-NJMS experience</td>
<td>125</td>
<td>45</td>
<td>45</td>
<td>88%</td>
<td>4%</td>
</tr>
</tbody>
</table>

Difficult Bile Duct Stone

Altered Anatomy

- Billroth-II, Roux-en-Y anastomosis
  - Difficult access because of long afferent limb
  - Pediatric colonoscope, standard EGD scope, or duodenoscope (Success rate 33% to 92%)
  - Overtube or balloon assisted (success rate 63%)
  - Lack of dedicated long accessories
  - Short DBE (success rate 81%)
- Success rate at Rutgers-NJMS in altered anatomy 77%

Shah R, et al. GIE 2013;77:593
Siddiqui et al. DDS 2013;58:858
Elderly

- Frequently have morbid underlying diseases, peri-ampullary diverticula & large multiple CBD stones
- Increased CP events, bleeding, 2 to 4 fold increase in mortality among octo- & nonagenarians
- EPLBD is as safe as ES
- ML or EHL may increase procedure time, which may result in increased CP events

Summary

- CBD stone 1-2 cm, CBD stone >lower CBD, altered anatomy
  - Papillotomy + conventional techniques if fails then “cut & dilate” with rescue ML; if failure then EHL
- CBD stone 2-3 cm
  - ML after papillotomy, if fails then EHL
- CBD stone >3 cm or impacted stone
  - EHL, if fails then refer to surgery