Management of Difficult Common Bile Duct Stones

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Objectives

• What makes a difficult biliary stone, “difficult”?

• What are the options for removal?

• Tips and tricks for management

• Take Home Points
What are the characteristics of a difficult biliary stone?

Scope of the problem

- 85-90% time: conventional methods and tools are effective for single session duct clearance
  - Endoscopic sphincterotomy (ES)
  - Balloon +/- basket extraction
Factors associated with “difficult” biliary stone

- 10-15% of all biliary stones
- Difficult:
  - Prolonged procedure time
  - >1 procedure for stone clearance
  - Need for unconventional tools
  - Need for surgery

Challenge #1: Access

Ampullary issue
- Periampullary diverticulum
- Duodenal obstruction

Altered anatomy
Challenge #1: Access

• Review OR records
• Choose the best scope for the job
  – Shorter the better
  – Duodenoscope: best option
  – Device assisted enteroscopy
• Have a back up plan
  – Referral to a more experienced interventional endoscopist
  – Percutaneous options?
  – Surgical referral

Percutaneous Cholangioscopy/Stone Therapy
Challenge #2: Stone factors

- **Number**
  - >3, impacted

- **Shape**
  - Non-round/oval

- **Size**
  - >15 mm
  (depends on size of distal duct)

- **Location**
  - Intrahepatic stones
    - PSC
    - Recurrent Pyogenic Cholangiopathy
  - Mirrizzi’s syndrome
Challenge #3: Duct factors

**Strictures**
- Distal CBD arm < 36 mm
- Distal CBD angle < 135°

Kim HJ, et al. GIE 2007;1154-1160
Challenge #4: Patient factors

- Coagulopathy

- Acuity of presentation
  - Shock/sepsis

Managing difficult biliary stones

- Pre-procedure
  - Know the patient’s anatomy (as best you can)
  - Review cross sectional imaging
  - Optimize coagulopathy
  - Pre-procedural antibiotics
  - Have tools available
  - Have a back-up plan
Menu of endoscopic options

- **Expand** the duct space
  - Endoscopic papillary balloon dilation

- **Reduce** the stone size
  - Mechanical lithotripsy
  - Electrohydraulic lithotripsy
  - Laser lithotripsy
  - Extracorporeal shock wave lithotripsy

- **Stenting** and *pharmacologic* therapy

- **Combination** of above

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“Expand”: Endoscopic papillary balloon dilation (EPBD)

- Introduced in 1983 as an alternative to ES\(^1\)

- US Multicenter RCT (vs ES): increased pancreatitis (15.4% vs 0.8%, \(P < .001\)) (including 2 deaths) led to its decline in the US\(^2\)

- Last 7 years: resurgence as an adjunct to ES for managing large stones (“endoscopic papillary large balloon dilation”)


“Expand”: Endoscopic papillary large balloon dilation (EPLBD)

• Combines advantages of EPBD and ES
  – Less bleeding and perforation associated with smaller ES
  – Less pancreatitis: small ES separates PD and CBD orifices

• First published 2003
  – 58 pts with difficult stones
  – 93% success without mechanical litho
  – 15% risk of complications

• Wire-guided balloons
• How big?
  – 10-20 mm
  – Limit to distal duct size
• How long?
  – <1 min for pts with ES (no diff 20 vs 60 secs)
  – >1 min longer for pts without ES (5 min >1 min)

Efficacy of EPLBD

- RCT of 156 pts ES vs ES+EPLD
  - Similar stone clearance (89%)
  - Similar complication rates (7% vs 10%)
  - Reduced need for mech lithotripsy (29% vs 46%)
  - Shorter procedure times/fluoro
  - Lower costs ($5025 vs $6005)

- Meta-analyses
  - 6 RCT/835 pts
  - ES+EPLBD: reduced complications (OR 0.53), less mech litho (OR 0.26, OR 0.15 for stones>15 mm)


Complications

- Up to 17%
- Bleeding: slow inflation/deflation may reduce
- Pancreatitis: ES first reduces risk. Primary EPBD should be used in selected cases (coagulopathy, post-op anatomy)
- Multicenter analysis
  - Perforation: most serious AE (0.4%, 7/1761)
    - Main RF: Distal CBD stricture (contraindication)

Prototype ES+ EPLBD catheter


Mechanical Lithotripsy

- Introduced 1982¹
- “Conventional” tools
- Most widely used technique for large biliary tract stones
- Engagement of stone and “crushing”

Mechanical Lithotripsy: Tools

- Crank/“Salvage” Lithotripsy
  - Lithotripsy compatible baskets
  - Basket impaction (with compatible baskets)

Mechanical Lithotripsy

- “Through the scope” approach
Mechanical Lithotripsy: Efficacy

- 162 pts with CBD stones for ML
- Cumulative probability of duct clearance
  
<table>
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<th>Size</th>
<th>Effect</th>
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<td>&lt;10mm</td>
<td>&gt;90%</td>
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<td>&gt;28mm</td>
<td>68%</td>
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- Other factors:
  - Duct size
  - Degree of impaction
  - Stone hardness

Garg PK, et al. GIE 2004; 601-605

Electrohydraulic Lithotripsy (EHL)

- Technology developed for industrial mining
- Introduced to ERCP in 1977
- Bipolar probe discharges sparks in liquid medium
- Pulse is transmitted as a hydraulic pressure wave onto stones
- Once fragmentation achieved, baskets and balloons used to extract

Electrohydraulic Lithotripsy (EHL)

- Non-contact
- Optimally performed with cholangioscopy guidance
  - Mother-daughter
  - Direct per oral or percutaneous applications
    - Post-operative anatomy
- Periprocedural abx


Electrohydraulic Lithotripsy (EHL)

- 94 pts with difficult biliary stones
  - Indications: large (>15mm) stones (n=81) or stenosis below a stone (n=13 patients)
  - Mother-daughter cholangioscopy
  - 76% (one session), 14% (2 sessions), and 10% (>3 sessions)
  - Post EHL: balloon or basket extraction of fragments.
  - Complications:
    - cholangitis and/or jaundice (n=13)
    - mild hemobilia (n=1)
    - mild post-ERCP pancreatitis (n=1)
    - biliary leak (n=1)
    - bradycardia (n=1)

Laser Lithotripsy (LL)

- Wavelength of light is focused on stone to induce wave mediated fragmentation through an aqueous medium (photothermal vaporization)
- Non-contact
- Pulsed (as opposed to continuous for tumor ablation)
- First used (Nd-YAG) in ERCP in 1986


Laser Lithotripsy (LL)

- Holmium YAG:
  - First used in 1998
- Most commonly used device
Laser Lithotripsy (LL)

• Prospective study in India
• 60 pts with difficult bile duct stones
• Spyglass cholangioscopy
• 365 um diameter fiber, with energy levels set at 800 to 1500 mJ at a frequency of 8 to 15 Hz.
• 83%: complete clearance after a single session; 17% required an additional session.
• Mean procedure times: 45.9 m (30-90 m)
• Complications: 13.5% of patients
  – Fever (n = 3)
  – Transient abdominal pain (n = 4)
  – Biliary stricture (n = 1).


Laser Lithotripsy vs EHL

• Comparative studies underway

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<td>Duct injury</td>
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Extracorporeal Shock Wave Therapy (ESWL)

- High pressure, focussed EHL shock waves transmitted to the stone
- Fluoro guidance
- US: Urologists
- Outside US: GI

ESWL Protocol

- Large CBD stone
  - Initial ERCP and NBT (for stone localization and to bathe the stone in saline)
  - ESWL till stones fragment to < 5 mm diameter
  - ERCP and CDD clearance with basket or balloon
  - Stenting only if indicated

Intensity of 4 (scale 1-6)
11 000-16 000 kV
Frequency: 90 shocks/min
Max of 5000 shocks/session

ESWL- Data

1031 cases (2004-2015)

55% Males, 45% Females

Age
- < 20 yrs: 2.0%
- 21-40 yrs: 16.3%
- 41-60 yrs: 47.5%
- > 61 yrs: 38.7%

Number of sessions
- ≤2: 23.9%
- 3-4: 47.9%
- >5: 28.5%

Tandan, M Asian Institute of Gastroenterology Data (DDW 2015)
ESWL - Complications

• Generally well tolerated
  – Transient hemobilia
  – Cholangitis
  – Pancreatitis
  – SQ Echymoses
• Stone recurrence rates 14% at 2 yrs¹


Stent therapy

• Used in patients with serious comorbidities, active coagulopathy, or with high acuity (sepsis)
• Effects
  – Drainage: reduced cholestasis/cholangitis
  – Mechanical action on stones to reduce size
  – Facilitates additional maneuvers
• Equivocal benefit of choleretic agents (ursodiol, terpene)¹²

Stent therapy

- 40 pts with large or multiple stones
- 2 mos of stenting with 7 Fr double pigtail stent

Horiuchi A et al. GIE 2010; 1200-1203
Surgery has a role

Some cases need multimodal treatment
Take Home Points

• Difficult biliary stones require an individualized approach:
  – Anatomy
  – Acuity
  – Comorbidities
  – Stone burden
  – Available tools and expertise

• Become comfortable with ES+PBL – WORKS!
• Adjunctive tools (LL/EHL) for patients with strictures or impacted stones
• ESWL in rare instances; Partner with a Urologist
• Stents for septic patients, refractory cases
• Do not forget about surgical options in truly refractory cases (who are candidates)
Thank you