History

xx y.o. pt with primary CBD stones s/p ERCP xx months earlier for attempted stone extraction resulting in post ERCP pancreatitis. Patient is now admitted for open CBD exploration. Complaining of intermittent RUQ pain radiating to the back and decreased appetite.

PMH: Hypercholesterolemia, HTN, gastritis
Meds: Zocor, Norvasc, Famotidine, Ambien
Allergies: NKDA
PSH: Cholecystectomy 1987, tubal ligation 1972
Soc: 4-5 cigs/day, occasional EtOH
Physical Exam

T 99°     BP 140/80     HR 90
Ht 5’ 2”   Wt 145 lbs

HEENT: Anicteric

Abd: Rt subcostal scar, +BS, nondistended, mild RUQ tenderness, no Murphy’s sign, no masses, no hernias

Rectal: guaiac negative
## Laboratory Values

<table>
<thead>
<tr>
<th>Test</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>AST</td>
<td>20</td>
</tr>
<tr>
<td>LDH</td>
<td>151</td>
</tr>
<tr>
<td>Albumin</td>
<td>4.3</td>
</tr>
<tr>
<td>GGT</td>
<td>25</td>
</tr>
<tr>
<td>TB/DB</td>
<td>0.3/0.1</td>
</tr>
<tr>
<td>Amylase</td>
<td>29</td>
</tr>
</tbody>
</table>
O.R.

Exploratory Laparotomy
LOA
IOC
CBD Exploration and removal of CBD stent
Choledochoduodenostomy
JP drain x1
OR time: 3.5 hours
EBL: 100cc
Hospital Course

POD#1 – NGT and Foley catheter removed
POD#3 – Full liquid diet
POD#4 – Regular diet, JP drain removed
POD#5 – Discharged home
Primary Common Bile Duct Stones
Primary CBD Stones

- Criteria
  - Form de novo outside of gallbladder in intrahepatic or extrahepatic bile ducts
  - Previous cholecystectomy with at least 2-year symptom free period
  - Absence of iatrogenic biliary stricture or long cystic duct remnant
  - Brown stones or sludge in CBD
Epidemiology

- 4-10% of CBD stones

- Brown to yellowish tan pigmented stones

- Association with bile stasis and infection
Presentation

- Recurrent biliary colic
- Jaundice
- Cholangitis
- Pancreatitis
Cholesterol Stones

- Form primarily in gallbladder
- 80% of gallstones in West
- Supersaturation of bile with cholesterol
- >70% cholesterol by weight
- <10% radiopaque
Black Pigment Stones

- Formed primarily in gallbladder

- Secondary to hemolytic disorders (i.e. hereditary spherocytosis and sickle cell disease) and cirrhosis

- Supersaturation of calcium bilirubinate, carbonate, and phosphate

- Increased levels of unconjugated bilirubin
Brown Pigment Stones

- Brownish-yellow and soft, <1 cm
- May form either in gallbladder or bile ducts
- Secondary to bacterial infection caused by bile stasis
- 58.7% of cholelithiasis in China

Brown Pigment Stones

- Percipitation of calcium bilirubinate and bacterial cells
- Bacterial deconjugation of bilirubin via $\beta$-glucuronidase
- E. coli, K. pneumoniae, bacteroides, Clostridium species
Pathogenesis of Pigmented Gallstones

- 370 patients from a Western population
- Incidence, appearance, chemical composition of pigment stones, and gallstone bacteria studied
- Bacterial identification by SEM and gallstone culture
- Chemical composition by IR spectroscopy

Pathogenesis of Pigmented Gallstones

Pathogenesis of Pigmented Gallstones

Table 1. Bacterial species cultured from pigment gallstones: Distribution, slime production, and β-glucuronidase production

<table>
<thead>
<tr>
<th>Bacterial species</th>
<th>No. of isolates</th>
<th>Slime production (%)</th>
<th>β-Glucuronidase production (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>E. coli</td>
<td>30</td>
<td>100</td>
<td>93</td>
</tr>
<tr>
<td>Enterococcus</td>
<td>27</td>
<td>85</td>
<td>0</td>
</tr>
<tr>
<td>Klebsiella</td>
<td>21</td>
<td>70</td>
<td>50</td>
</tr>
<tr>
<td>Enterobacter</td>
<td>10</td>
<td>63</td>
<td>38</td>
</tr>
<tr>
<td>Pseudomonas</td>
<td>8</td>
<td>100</td>
<td>60</td>
</tr>
<tr>
<td>Citrobacter</td>
<td>7</td>
<td>75</td>
<td>33</td>
</tr>
<tr>
<td>Xanthomonas maltophilia</td>
<td>5</td>
<td>100</td>
<td>0</td>
</tr>
<tr>
<td>Non-Enterococcusstreptococcus</td>
<td>7</td>
<td>100</td>
<td>0</td>
</tr>
<tr>
<td>Staphylococcus species</td>
<td>4</td>
<td>100</td>
<td>0</td>
</tr>
<tr>
<td>Other (Aeromonas hydrophila, Bacteroides, Clostridium, Serratia, Proteus, nonspeciated gram-negative rods, yeast)</td>
<td>16</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>TOTAL</td>
<td>135</td>
<td>83</td>
<td>44</td>
</tr>
</tbody>
</table>

Pathogenesis of Pigmented Gallstones

Pathogenesis of Pigmented Gallstones

- 73% pigmented stones contained bacteria
- Ca-bilirubinate present in all pigment stones
- Ca-palmitate characteristic of infected stones
- Ca-carbonate characteristic of sterile stones

Pathogenesis of Pigmented Gallstones

- 95% bacteria produced slime
- 67% of bacteria produced β-glucoronidase
- Bacteria have a major role in Western pigment gallstone formation

Evaluation

- Liver function tests and amylase
- US
- CT scan
Evaluation

- ERCP
  - Primary diagnostic and therapeutic modality
  - Sphincterotomy and stone extraction
  - Placement of stent if stone extraction unsuccessful
  - Mortality rate 1.5%
Open CBD Exploration

- **Indications**
  - Presence of multiple stones (more than 5)
  - Stones > 1 cm
  - Multiple intrahepatic stones
  - Distal bile duct strictures
  - Failure of ERCP
  - Recurrence of CBD stones after sphincterotomy
CBD Exploration - Surgical Options

- Common duct exploration with T-tube decompression
- Choledochoduodenostomy
- Transduodenal sphincterotomy and sphincterplasty
- Roux-en-Y choledochojejunostomy
CBD Exploration with T-tube

- Ideal for patient with 1-3 distal stones
- Non dilated ducts
- T-tube kept for 3-6 weeks
- Cholangiogram prior to removal of T-tube
CBD Exploration with T-tube

- Retrospective review 30 patients undergoing CBD exploration for primary CBD stones
- Stone extraction and T-tube drainage only
- 18% stone recurrence rate at 4 years
- 3 patients requiring reoperation for stone extraction and definitive drainage

Choledochoduodenostomy

- Introduced by Sprengel 1891
- CBD must be > 1.5 cm
- Low morbidity and mortality
- 5% rate of cholangitis and “Sump” Syndrome
Choledochojejunostomy

- Can be performed for CBD < 1.5 cm
- Following previous open CBD exploration
- 2% risk of duodenal ulcer formation
Transduodenal Sphincterotomy and Sphincteroplasty

- Used primarily for impacted stones at the ampulla
- Definitive treatment of ampullary stenosis
- Access to pancreatic duct
- T-tube drainage optional
Long-term Prognosis After Tx

- 213 pts treated between 1982 and 1996 for choledocholithiasis
- 3 groups - T-tube drainage (87), choledochoduodenostomy (44), and EST (82)
- Mean follow-up 9.6 years in outpatient clinic

Long-term Prognosis After Tx

<table>
<thead>
<tr>
<th>Treatment Procedures</th>
<th>T-Tube Drainage</th>
<th>Choledochoduodenostomy</th>
<th>EST</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. of patients (P/S)</td>
<td>87 (12/75)*</td>
<td>44 (42/2)</td>
<td>82 (36/46)</td>
</tr>
<tr>
<td>No. of recurrent patients (P/S)</td>
<td>9† (5/4)</td>
<td>0</td>
<td>8† (6/2)</td>
</tr>
<tr>
<td>Recurrence rate (P/S)*</td>
<td>10.3§ (41.7/5.3)</td>
<td>0</td>
<td>9.8§ (16.7/4.3)</td>
</tr>
</tbody>
</table>

## Long-term Prognosis After Tx

### TABLE 5. Digestive Disease After the Treatment for Choledocholithiasis

<table>
<thead>
<tr>
<th></th>
<th>T-tube (n = 87)</th>
<th>Choledochoduodenostomy (n = 44)</th>
<th>EST (n = 82)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cholangitis</td>
<td>2</td>
<td>1</td>
<td>4*</td>
</tr>
<tr>
<td>Cholecystitis</td>
<td>0</td>
<td>0</td>
<td>6</td>
</tr>
<tr>
<td>Enteritis (severe)</td>
<td>1</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Pancreatitis</td>
<td>1</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>Gastric ulcer</td>
<td>2</td>
<td>3†</td>
<td>1</td>
</tr>
<tr>
<td>Gastritis (severe)</td>
<td>1</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>Gastric cancer</td>
<td>0</td>
<td>4</td>
<td>0</td>
</tr>
<tr>
<td>Esophageal cancer</td>
<td>0</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Colon cancer</td>
<td>0</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Total</td>
<td>7 (8.0%)</td>
<td>12 (27.3%)†</td>
<td>14 (17.1%)</td>
</tr>
<tr>
<td>Death (by other disease)</td>
<td>2</td>
<td>3</td>
<td>5</td>
</tr>
</tbody>
</table>

Long-term Prognosis After Tx

<table>
<thead>
<tr>
<th></th>
<th>T-Tube Drainage (n = 87)</th>
<th>Choledochoduodenostomy (n = 44)</th>
<th>EST (n = 82)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Death</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Cholangitis</td>
<td>0</td>
<td>0</td>
<td>4</td>
</tr>
<tr>
<td>Pancreatitis</td>
<td>0</td>
<td>0</td>
<td>4</td>
</tr>
<tr>
<td>Disturbance of liver function</td>
<td>8</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>Bile leakage</td>
<td>5</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>Wound infection</td>
<td>1</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>Intraabdominal abscess</td>
<td>0</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>Ileus</td>
<td>0</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Pneumonia</td>
<td>1</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Others</td>
<td>1*</td>
<td>1†</td>
<td>1‡</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>16 (18.4%)</strong></td>
<td><strong>9 (20.5%)</strong></td>
<td><strong>12 (14.6%)</strong></td>
</tr>
</tbody>
</table>

# Long-term Prognosis After Tx

**TABLE 4. Characteristics of Patients with Recurrent Choledocholithiasis**

<table>
<thead>
<tr>
<th></th>
<th>Recurrent Cases</th>
<th>Nonrecurrent Cases*</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. of patients</td>
<td>17</td>
<td>152</td>
</tr>
<tr>
<td>Age during the initial treatment</td>
<td>$70.2 \pm 10.9$</td>
<td>$68.9 \pm 16.3$</td>
</tr>
<tr>
<td>Sex (M/F)</td>
<td>7/10</td>
<td>72/80</td>
</tr>
<tr>
<td>No. of stones</td>
<td>$3.1 \pm 2.1$</td>
<td>$2.6 \pm 1.5$</td>
</tr>
<tr>
<td>Max. diameter of the common bile duct (mm)</td>
<td>$16.6 \pm 5.9^\dagger$</td>
<td>$12.8 \pm 4.9$</td>
</tr>
<tr>
<td>Peripapillary diverticulum (yes/no)</td>
<td>10/7$^\ddagger$</td>
<td>34/118</td>
</tr>
<tr>
<td>Primary bile duct stones/secondary bile duct stones</td>
<td>11/6$^\ddagger$</td>
<td>37/115</td>
</tr>
<tr>
<td>Years to recurrence of lithiasis (primary/secondary)</td>
<td>$4.2 \pm 2.1/5.4 \pm 3.2$</td>
<td>—</td>
</tr>
</tbody>
</table>

Summary

- Lowest rate of stone recurrence with choledochoduodenostomy
- Primary duct stones more common in recurrent patients
- Choledochoduodenostomy is recommended for older patients with primary common bile duct stones

Summary

- A high index of suspicion for primary common bile duct stones is needed to avoid complications and provide prompt treatment.
- ERCP is the primary therapeutic intervention available.
- Surgical options should be tailored to individual patients.