Imaging For Suspected Bile Leak Following Cholecystectomy

Kyle Checchi, Harvard Medical School Year IV
Gillian Lieberman, MD
Our Patient: Presentation

• Middle aged male with h/o chronic cholecystitis s/p CCY 2 weeks prior transferred from OSH immediately following aborted endoscopic CBD stone removal with impacted stone grasper

• Patient arrives at BIDMC with endoscopic stone grasper wire secured to himself with a Kelly clamp
Our Patient: Recent History

• Additional prior intervention details:

  – 2 weeks prior:
    • CCY: Standard procedure aborted, Thorek cholecystectomy completed, stones suspected in CBD
      – In the Thorek procedure, the gallbladder wall is divided at the border with the liver
    • ERCP: Failed CBD stone extraction, temporary CBD stent placed to bypass stone

  – Day of presentation:
    • ERCP: Failed repeat CBD stone extraction, impacted stone grasper, ? CBD leak below cystic duct stump
Imaging Guidelines

• ACR has published intervention guidelines:

  
  
<table>
<thead>
<tr>
<th>Clinical Condition:</th>
<th>Radiologic Management of Benign and Malignant Biliary Obstruction</th>
</tr>
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<tbody>
<tr>
<td>Variant 10:</td>
<td>Initial therapeutic procedure for a patient with bile leak and dilated bile ducts following laparoscopic cholecystectomy.</td>
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<table>
<thead>
<tr>
<th>Treatment/Procedure</th>
<th>Rating</th>
<th>Comments</th>
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<tbody>
<tr>
<td>Endoscopic internal biliary catheter</td>
<td>8</td>
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<tr>
<td>Percutaneous internal/external biliary catheter</td>
<td>8</td>
<td>Most appropriate whenever endoscopic treatment is unsuccessful and after drainage of ascites</td>
</tr>
</tbody>
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Rating Scale: 1,2,3 Usually not appropriate; 4,5,6 May be appropriate; 7,8,9 Usually appropriate

• While not scored, ACR recommends the following for imaging:
  – Preoperative identification of the location and extent is most beneficial in planning treatment
  – US, CT, and MRCP
  – CT imaging has achieved marked improvement in anatomic detail

• CT will generally provide more useful data and will be necessary to plan management if a leak is observed (Sabiston)

Our Patient: Iatrogenic Bile Duct Injury on CT

- Axial O+/C+ abdominal CT

- Pause to review image, then continue to see findings
Our Patient: Iatrogenic Bile Duct Injury on CT

- Axial O+/C+ abdominal CT

- Key findings:
  - Extraluminal air and oral contrast collecting around the gallbladder fossa
  - Biliary air and metallic foreign body (stone grasper wire)
  - Incidentally discovered simple renal cyst
Our Patient: Iatrogenic Bile Duct Injury on CT

- Coronal O+/C+ abdominal CT

- Pause to review image, then continue to see findings
Our Patient: Iatrogenic Bile Duct Injury on CT

• Coronal O+/C+ abdominal CT

• Key findings:
  – Proximal CBD stent with oral contrast
  – Reflux of contrast into cystic duct stump
  – Distal CBD stent with oral contrast and air
Our Patient: Iatrogenic Bile Duct Injury on CT

- Coronal O+/C+ abdominal CT

- Pause to review image, then continue to see findings
Our Patient: Iatrogenic Bile Duct Injury on CT

- Coronal O+/C+ abdominal CT

- Key findings:
  - **Biliary air**
  - **Proximal CBD with oral contrast**
  - Stone grasper **basket** (around stone) and **wire** (in duodenum)
Our Patient: Course and Outcome

- Prior to CT, patient underwent CCY and 2 ERCPs complicated by cystic duct stump leak

- CT used appropriately to define anatomy and characterize the iatrogenic bile duct injury
  - Facilitated choice and planning of appropriate intervention (in this case ERCP)

- Patient’s cystic bile duct leak was successfully bypassed via endoscopic CBD stenting

- Patient is recovering well
Outline

Our patient

- Using imaging to inform therapeutic interventions following iatrogenic bile duct injury:
  - Defining bile duct system anatomy
  - Radiographic classification of iatrogenic bile duct leaks

- Summary
Advanced Biliary Anatomy

• Cystic to CBD insertion anomalies
  – A: right lateral insertion
  – B: anterior spiral with medial insertion
  – D: low lateral insertion with common sheath
  – E: proximal insertion
  – F: low medial insertion with long parallel course

Cystic to CBD Insertion Anatomy on ERCP

• Index Case 1: Classic anatomic right lateral insertion
  – Cystic duct (2 arrows)

Cystic to CBD Insertion Anatomy on ERCP

- Index Case 2: Anterior spiral with medial insertion
  - Cystic duct (3 arrows)

Cystic to CBD Insertion Anatomy on ERCP

- Index Case 3: Posterior spiral with long parallel course and low insertion
  - Cystic duct (2 straight arrows)
  - CBD (single curved arrow)

Anatomy: R Posterior Bile Duct Variances

• A: Right posterior duct paralleling and joining the CBD adjacent to the cystic duct
• B: Right posterior duct joining distal to right and left hepatic duct junction
• C: Right posterior duct joining cystic duct

Aberrant R Posterior Bile Duct on ERCP

• Index Case 4: Right posterior duct joining cystic duct
  
  – R posterior duct (2 smaller arrows)

  – Cystic duct distal to intake of R posterior duct (larger single arrow)

Aberrant R Posterior Bile Duct on MRCP

- Index Case 5: Aberrant right posterior duct paralleling and inserting into the CBD adjacent to the cystic duct
  - R posterior duct (2 small arrows)
  - Cystic duct (larger single arrow)

Our patient

- Using imaging to inform therapeutic interventions following iatrogenic bile duct injury:
  - Defining bile duct system anatomy
    - Radiographic classification of iatrogenic bile duct leaks

- Summary
Strasburg Classification of Iatrogenic Bile Duct Injuries

- Classification system for iatrogenic bile duct injuries
  - A: cystic duct leak
  - B: right aberrant duct ligation
  - C: right aberrant duct leak
  - D: CBD injury (<50%)
  - E1: CBD injury (>50%, <2cm from junction)
  - E2: CBD injury (>50%, <2cm from junction)
  - E3: CBD injury (high)
  - E4: CBD injury (dividing left and right hepatic ducts)
  - E5: CBD and right aberrant injury

Iatrogenic Bile Duct Injuries on ERCP

- Index Case 6: Cystic stump leak (Strasburg A)
  - Cystic duct (Arrowhead)
  - Extravasated contrast agent (Arrows)
Iatrogenic Bile Duct Injuries on ERCP

- Index Case 7: Strictures preventing union of right and left hepatic ducts (Strasburg E4)
  - R hepatic duct stricture
  - L hepatic duct
  - CBD

Left image: Neel B. Patel; Aytekin Oto; Stephen Thomas; RadioGraphics 2013, 33, 1867-1888. DOI: 10.1148/rg.337125038
Our patient

Using imaging to inform therapeutic interventions following iatrogenic bile duct injury:

- Defining bile duct system anatomy
- Radiographic classification of iatrogenic bile duct leaks

Summary
Summary

- Our patient
  - Cystic duct leak following CCY (also with CBD stone and retained endoscopic equipment)
  - CT is the imaging study of choice for iatrogenic bile duct injury (following or without US)
  - Patient recovered well after ERCP recovery of the stone grasper, CBD stone, and CBD stenting to bypass the cystic duct

- The utility of CT for defining anatomy and characterizing the iatrogenic injury
  - Advanced biliary anatomy
    - Cystic and CBD junction
    - Right posterior duct
  - Strasburg classification
    - A-D, E1-E5
References


- Neel B. Patel; Aytekin Oto; Stephen Thomas; *RadioGraphics* 2013, 33, 1867-1888.


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