What the surgeon and radiologist needs to know about intraoperative cholangiography

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Disclosure

We have no actual or potential conflict of interest in relation to this presentation.
Goals and Objectives

• This exhibit aims to demonstrate normal/abnormal intraoperative cholangiograms and show their utility to the surgeon and radiologist. Our goal is to demonstrate examples of normal/aberrant biliary anatomy, abnormalities that may change further management, and rare surgical complications. We further aim to correlate IOCs with relevant clinical and laboratory data.
Target Audience

• The target audience for this presentation is radiology and surgical residents and fellows.
Goals of Intraoperative Cholangiography (IOC)

- Principle goal of IOC is to recognize problems in real time that may influence further management
  - Recognize abnormalities that require immediate surgical intervention
  - Recognize abnormalities that require urgent ERCP (e.g. retained calculi)
- Prevention and recognition of bile duct injuries
- Elucidate liver and pancreatic enzyme elevations
- Clarify biliary anatomy
Technique

• Surgical technique is per the performing surgeon’s preference

• The important radiographic considerations in performing IOC are:
  • Fluoroscopic images must be obtained prior to cystic duct ligation and removal of gallbladder to ensure proper opacification of the biliary system
  • Sterile C-arm fluoroscope must be tilted in such a way so that the common bile duct is not superimposed over the spine or surgical instruments. Repositioning and re-angling is recommended to ascertain the fine details that may be otherwise partially obscured
  • Diluted contrast is preferred over concentrated so as to not obscure retained stones

• Use of IV Glucagon
  • Causes relaxation of the sphincter of Oddi
  • Used to “flush” small stones or when the common bile duct is not seen emptying into the duodenum
Patterns of IOC imaging

- Retained calculi
- Biliary obstruction
- Surgical complications
- Aberrant anatomy and fistulas
- Fluoroscopic artifacts
Case 1: Normal IOC

- 38 year old female presented with symptomatic cholelithiasis without cholecystitis
- IOC was performed because common bile duct measured upper limits of normal on ultrasound (0.6 cm)
- Contrast injected into cystic duct is seen outlining common bile duct and flowing into duodenum
- Note the faint filling of common, left and right hepatic ducts
- Contrast should normally flow antegrade with only faint filling of the intrahepatic ducts. Overfilling of the intrahepatic ducts suggests distal obstruction.
- Black arrow: subxyphoid port
- White arrow: falciform ligament
Retained biliary calculi

• Classic imaging characteristic is a fixed meniscoid filling defect
• “Floating” stones – mobile biliary calculi that are not impacted in the bile ducts
  • Contrast dilution is important as concentrated contrast will obscure floating stones, especially with dilated bile ducts
Case 2: Obstructive retained stone

• Obstruction of CBD by meniscoid filling defect above the sphincter (white arrow). Note the overfilling of intrahepatic bile ducts.

• Unrelated aberrant anatomy: posterior segment of right lobe of liver drains into left hepatic duct
Case 3: Obstructing calculi

• 32 year old female presented with acute cholecystitis. The IOC was initially read as “negative” in the operating room.

• First image exhibits obstruction with no contrast in the duodenum due to retained stone (arrow).

• Second image shows partial obstruction with minimal contrast in the duodenum and floating stones (arrow) after additional contrast administration.

• Subsequent ERCP with balloon sweep yielded retained stones
Case 4: Pancreatitis due to retained stone

- 42 year old male presented with mildly elevated LAEs, hyperbilirubinemia, cholelithiasis on ultrasound, abdominal pain
- IOC read as “negative” in the OR. This image shows small stone at the Ampulla of Vater (white arrow) with reflux of contrast into pancreatic duct (blue arrow) causing an acinogram (black arrows).
- On post-op day #1, patient had increasing abdominal pain. Labs showed lipase of 26,000 (normal at admission) and CT showed findings of acute uncomplicated pancreatitis
- ERCP performed on post-op day #2 commented on difficulty cannulating ampulla due to impacted stone. Stone was subsequently removed with balloon sweep
Case 5: Multiple retained calculi

- Multiple stones partially obstruct CBD (white arrows). Note minimal amount of contrast into duodenum (black arrows) and overfilling of intrahepatic ducts.

- Unrelated aberrant anatomy: aberrant drainage of right posterior hepatic segment into the cystic duct. This was not seen by the surgeons or gastroenterologists during subsequent ERCP with balloon sweep for stones.
Case 6: Gallstone pancreatitis, retained stone

- 43 year old female presented with gallstone pancreatitis
- Small stone in CBD above sphincter of Oddi causes partial obstruction (white arrow) with excessive filling of intrahepatic ducts
- Swelling of pancreatic head causes mild narrowing at the pancreatic portion of CBD (blue arrow)
Case 7: Retained stones

- Laparoscopic cholecystectomy converted to open due to excessive adhesions around gallbladder and CBD.
- Cystic duct was not amenable to cannulation, so contrast is injected into the CBD.
- Obstructive stone above the sphincter of Oddi (white arrow). Additional stone above the takeoff of cystic duct (black arrow).
- Unrelated aberrant anatomy: anomalous drainage of posterior right hepatic segment into common hepatic duct.
Biliary obstruction

• Common bile duct obstruction
  • Commonly caused by calculus, neoplasm, stricture
  • Represented as slow or absent contrast flow into the duodenum
  • Retrograde flow of contrast and overfilling of the peripheral intrahepatic bile duct branches
  • Edema and inflammation from acute pancreatitis
  • Mirizzi’s Syndrome

• Cystic duct obstruction
  • Retained stones
  • Surgical clips
  • Mirizzi’s syndrome – generally causes cystic duct obstruction followed by common duct obstruction
Case 8: Pancreatitis due to current/recent obstruction

• 35 year old female presented with acute pancreatitis
• Overfilling of intrahepatic bile ducts suggest distal obstruction
• No definitive stone visualized. Obstruction may be explained by either obscuration of small calculus by dense contrast or by edema from a recently passed stone.
• Unrelated anatomic anomaly: anomalous low junction of the right and left hepatic ducts
Case 9: Cystic duct obstruction

- 47 year old female presented with gallstone pancreatitis
- IOC was attempted
- Per the operative report, there was “consistent leakage of contrast around the puncture site” that was not corrected even with repositioning the catheter. IOC was subsequently abandoned
- Image shows contrast in the subhepatic space (white arrow) with no opacification of the biliary ducts
- The linear opacity projecting over the spine is the falciform ligament (black arrow), often mistaken for the common bile duct.
Case 10: Obstructive stone: effects of glucagon

- This image is taken prior to glucagon administration.
- Opacification of CBD and overfilling of common, left, right, and intrahepatic ducts and no contrast into the duodenum indicative of obstruction due to retained stone at the level of the sphincter (white arrow).
- Unrelated aberrant anatomy: drainage of the right posterior segmental duct into the left hepatic duct.
Case 10 (continued)

- After IV glucagon administration, there is apparently decreased opacification of intrahepatic ducts, normal filling into the duodenum, and no filling defect.

- Pre-operative labs indicate obstruction:
  - Total bilirubin 1.7, Direct bilirubin 1.0
  - Alkaline phosphatase 256
  - AST 245
  - ALT 136
Surgical complications

• Primarily related to biliary duct injuries or cystic duct avulsion
• Accidental ligation of bile ducts
• Bile duct narrowing adjacent to surgical clip
Case 11: Surgical complication – partial CHD obstruction

- Focal narrowing of common hepatic duct (black arrow) next to surgical clip (white arrow).
- Labs on the day of and after surgery:
  - ALT: 147 → 198
  - AST: 464 → 529
  - Alkaline phosphatase: 161 → 173
Aberrant anatomy and fistulas

• Examples:
  • Cystic duct drainage into the right or left hepatic duct
  • Cystic duct drainage into the duodenum
  • Right hepatic duct or segmental duct draining into the cystic duct
    • Clinically important to recognize prior to ligation of cystic duct

• Contrast entering duodenum or colon prior to opacification of common bile duct is suggestive of a fistula
Case 12: Aberrant anatomy

- IOC performed in 38 year old male for acute cholecystitis.
- Anomalous drainage of cystic duct into the right hepatic duct.
- IOC is otherwise negative – no obstructions or retained stones.
Case 13: Aberrant anatomy

- Aberrant drainage of right posterior hepatic segment into the cystic duct (black arrow)
- Clipping the cystic duct with this anatomic variant can lead to obstruction of the draining hepatic segment
Fluoroscopic artifacts

- Falciform ligament may mimic the non-opacified common bile duct
- Air bubbles during injection may be misidentified as biliary calculi
- Spine and surgical instruments can obscure stones or other details; this may be corrected by tilting of the C-arm
- Blooming effect of the fluoroscopic screen caused by faulty exposure factor settings
- Poor detail can result from underexposure (due to technique settings or patient body habitus)
Case 14: Fluoroscopic artifact

Note how projection of CBD over spine obscures tiny stone at the papilla
Summary and Clinical Implications

• IOC is essential in the perioperative management of patients during cholecystectomies, especially those requiring additional biliary procedures

• Real-time awareness of common pathology and anatomical variants is important as it can influence immediate surgical management, minimize/recognize complications, and help plan future interventions if necessary
References


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